HE ENGINEERING CONSTRUCTION WEEKLY

# ENGINEERING NEWS-RECORD

OCT 28 1939

OCTOBER 26
1939

Engineering Library

## BUILDINGS

Ten notable buildings of 1939—factories, office buildings, housing, power plants and public buildings—described in a special section.

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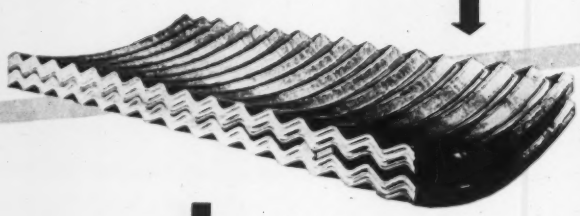

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MULTI ARMCO PLATE

## ARMCO MULTI PLATE

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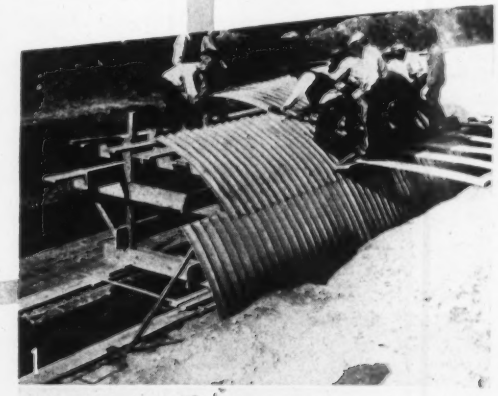

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# ENGINEERING NEWS-RECORD

*Devoted to Buildings, Sewers, Waterworks, Bridges, Highways, Streets, Dams, Foundations, Earthwork, Flood Control, Public Works, Irrigation, Canals, Railroads*

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Vol. 123 *October* 26, 1939 No. 17

| | PAGE |
|---|---|
| The Week's Events | 31–102 |
| Reader Comment | 38 |
| Editorials | 40 |
| Washington Revises Its Famous Circles<br>H. C. WHITEHURST | 42 |
| Sanitary Survey at Grand Rapids, Mich. | 44 |
| Building Settlement Checked Successfully<br>WALTER H. WHEELER | 45 |
| Typical Small Earthfill Dam | 47 |
| Median Strips at Highway Intersections | 50 |
| Public Works Parley in Pittsburgh | 54 |
| Driven Cylinder Foundations Built Rapidly | 55 |
| Book Notes and Reviews | 58 |
| Contract Unit Prices | 98 |
| New Aids to the Constructor | 108 |
| Construction Reports | 135 |

PORTFOLIO OF 1939 BUILDINGS

| | PAGE |
|---|---|
| Office Building, Des Moines<br>LELAND A. MCBROOM | 63 |
| Tire Factory at Natchez<br>ANTON TEDESKO | 67 |
| Apartment Housing, New York | 70 |
| Coffee Roasting Plant, Hoboken | 73 |
| Power Plant, Holland, Mich.<br>R. F. GIFFELS | 75 |
| Automobile Press Shop, Detroit<br>ALBERT KAHN | 78 |
| High School, Girardville, Pa. | 82 |
| Baking Soda Plant, Syracuse | 84 |
| Municipal Building, Topeka<br>R. A. COOLIDGE | 88 |
| Drafting Offices, Chicago | 92 |

## THIS WEEK

TEN OUTSTANDING BUILDINGS of the year are described in the "Portfolio of 1939 Buildings," a special section this issue. Features of each of the structures are:

**Bankers Life Co. office building,** Des Moines: Long span girders, cut for passage of air ducts and plumbing; continuous floor beams; expensive materials for low maintenance; enameled steel interior finish.

**Armstrong tire factory,** Natchez, Miss.: Monolithic concrete construction with thin-shell multiple-barrel roof for economy and light reflection.

**Castle Village apartments,** New York City: Tall concrete apartment buildings; pipes in walls; soundproof partitions; garage on premises.

**Maxwell House coffee plant,** Hoboken: Heavy concrete flat slab construction; a completely integrated plant.

**Municipal power plant,** Holland, Mich.: Boilers and condensers on mat foundations separate from building; steel frame enclosed by 25-in. walls.

**Ford press shop,** Dearborn, Mich.: Long steel piles supporting 3-ft. concrete mat; removable framing; mechanical facilities concentrated at columns; unusual air treatment.

**High school,** Girardville, Pa.: Enameled steel plate walls for lightness and cleanliness.

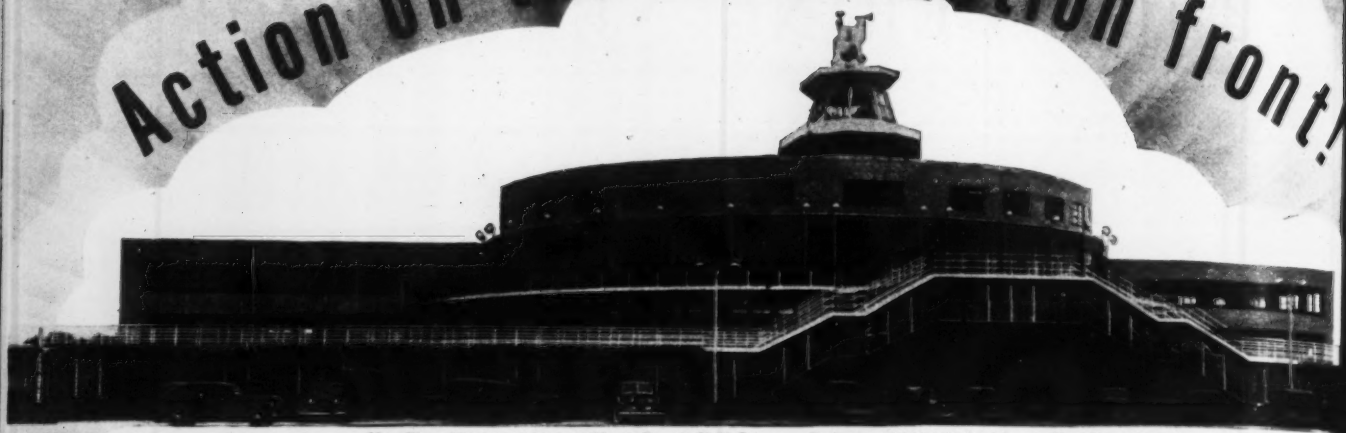
**Church & Dwight plant,** Syracuse: Welded frame; glass block construction; three types of air treatment.

**Municipal auditorium,** Topeka, Kans.: Combined city hall and civic auditorium; air conditioned throughout.

**Pullman engineering offices,** Chicago: Low-cost but efficient offices and drafting room; long-span roof construction to eliminate columns.

ALSO IN THE ISSUE is an important contribution to highway design work, a report on how median strips for divided highways should be designed to provide maximum safety at intersections; a description of how Washington's famous circles are to be rebuilt to relieve traffic congestion; an article on how foundations for bridge piers at Cleveland are being carried to rock through deep clay beds—supplementing the description of another novel method of doing similar work at Chicago published in the Oct. 12 issue; and an account of how the progressive settlement of a large school building was stopped successfully.

# Action on the construction front!



*New York Municipal Airport, North Beach, N. Y. C.* *Delano and Aldrich, Architects, New York City*

# Truscon Cooperating

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• Increasing action along the entire engineering construction front is evidenced by the vast sum of more than a billion dollars of engineered buildings erected or to be included in the 1939 total of these projects. • Available time of consulting architects and engineers, contracting and construction companies and other principals in the industry is stretched to a point where waste motion is the most serious obstacle to progress. • Here is where Truscon, with its wide scope of steel products for the building industry, its nationwide network of sales-engineering offices and conveniently located warehouses is in a strategic position to help YOU by relieving you of a diversity of details. • Check the lists of Truscon Steel Products on this page just to see *how many* responsibilities YOU can concentrate in ONE source — TRUSCON!

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**ROAD REINFORCING**
WELDED STEEL FABRIC
CONTRACTION PLATES
ROAD FORMS
GUARD RAIL

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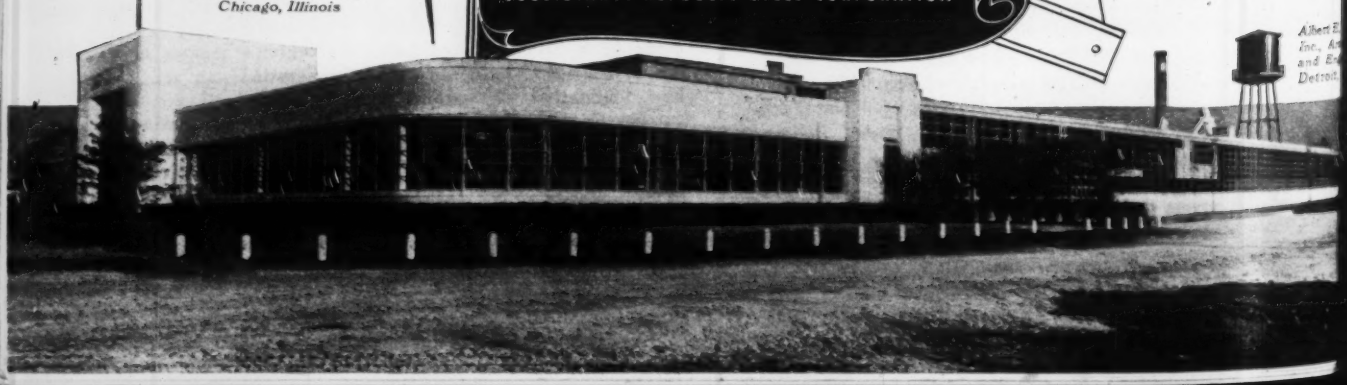
*Lady Esther Building*
*Chicago, Illinois*

TRUSCON



ENGINEERING NEWS-RECORD

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## *Illinois Typhoid Epidemic Under State Inquiry*

A state inquiry is being made as to the cause of and responsibility for the continuing typhoid fever epidemic at the Illinois State Hospital for the Insane, Manteno, Ill., where more than 50 deaths have occurred since the first case was diagnosed in July, and where over 350 cases are still held in isolation. Immunization of patients and attendants was ordered Aug. 13, and chlorination of the deep-well water supply began Aug. 19. On Aug. 31 the typhoid bacillus was identified in a culture made from a sample from one of the four wells which supply the institution. The milk supply was also reported under suspicion.

Apparent neglect in management of the hospital and omission of normal precautions against disease are the basis of an inquiry started by the state's attorney of Kankakee county. Evidence taken has shown that the state board of health had given several warnings as to the suspicious or dangerous condition of the water supply. There is now said to be fear of an epidemic of dysentery at the same institution. Meanwhile arrangements are reported for supplying water from the city of Kankakee by glass-lined tank trucks.

Other details of the epidemic and its apparent origin are given in *ENR*, Sept. 7, p. 306, and Sept. 28, p. 385.

• • •

## *Green Mountain Dam Strike Cost Colorado $28,000*

When workers on the Green Mountain Dam in Colorado went on strike and the Colorado National Guard was called out to occupy the site for 25 days, cost of the interference was $28,000, according to state figures which have just been released.

The work, part of the Bureau of Reclamation Colorado-Big Thompson irrigation and power project, had been shut down since July 12. The troops were started to the site Aug. 4 (*ENR*, Aug. 10, 1939, p. 179).

**NEW WAGE-HOUR HEAD**

LIEUT. COL. PHILIP B. FLEMING last week was named administrator of the federal wages and hours law to replace Elmer F. Andrews. Fleming was assistant administrator of PWA from 1933 to 1935, leaving that position to head the Passamaquoddy tidal power project. Further details of the change are given on p. 33.

## *$6,000,000 Project Begun In North Carolina*

Construction work has begun by the Duke Power Co. on a $6,000,000 improvement of the company's steam electric power plant on the Yadkin River at Dukeville, N. C. The plant, which will have a capacity of 100,000 hp., is scheduled for completion by June 1, 1941.

• • •

## *Stage of Mississippi Reaches All-Time Low*

The stage of the Mississippi River at Greenville, Miss. on Oct. 15 reached an all-time low of —4.4 ft. The previous record low water at Greenville was —4.2 ft. recorded Aug. 27, 1936.

## *Government Studies Building Industry*

**Investigation of monopolistic practices begun in Cleveland and Pittsburgh, others to follow**

Within a week or two a grand jury investigation of the building industry in St. Louis will be added to the investigations already underway in Cleveland and Pittsburgh. And within six weeks to two months grand juries will be at work in Chicago, New York, New Orleans, San Francisco, Los Angeles, Seattle, and Detroit. No one can predict what a grand jury will do, but indictments are expected at Cleveland within thirty days.

Into each of these cities the federal Department of Justice has thrown a staff of five to ten men with orders to determine the extent of monopolistic practices in building. Supplementing this horizontal investigation of the situation in each city is a vertical probe of all the elements—from manufacturer

(*Continued on p. 34*)

• • •

## *Staff Changes Announced At Armour Institute*

L. E. Grinter, director of civil engineering and dean of the graduate division of Armour Institute of Technology in Chicago, has been appointed vice-president of the institute. In this capacity, all internal administration matters will be under his direction. R. C. Huntly, formerly head of the mechanical engineering department, has been appointed to Dean Grinter's position as head of the civil engineering department. Other changes in the civil engineering staff include the following new appointments: Rolf Eliassen, Dorr Co., assistant professor; LeVan Griffis, California Institute of Technology, instructor; Joseph Marin, Rutgers University, associate professor, and Merit P. White, California Institute of Technology, assistant professor.

# Building, & Bridges and Elevated Highways Discussed by Steel Fabricators

**American Institute of Steel Construction convention hears reports on structural research, welded bridges, skyscrapers and highway safety**

With a large proportion of its 132 steel fabricator members present, the American Institute of Steel Construction, meeting at New York Oct. 17-18, discussed a range of subjects extending from elevated highways and the failure of the Hasselt welded bridge in Belgium to the efficiency of skyscrapers. Reports of completed and current research work in the field of structural steel showed a steadily maintained program. Tests of rigid steel frames have been completed; a traffic test of thin asphaltic roadway surfacing on a steel plate floor is still in progress at Bethlehem, Pa., as are also tests of plate girder splices at Columbia University and stress distribution tests on short columns at Lehigh. A program of tests of stress distribution in cover plates having large-size inspection holes is about to begin.

Collection of data on cold riveting has been initiated by the institute, it was reported. Other studies relate to cleaning structural steel, especially by flame, which process has been used for about 50,000 tons so far. Specifications for welded steel structures are in preparation.

President Clyde G. Conley in his address to the institute looked forward to marked increase in industrial plant expenditures, in airplane and shipbuilding plants as well as in the heavy industries in general. Pointing to increasing city congestion and the new trend of population towards the city, he expressed the view that elevated highway construction will in time constitute a large item of demand.

## Skyscrapers defended

Henry Wright, associate editor, *Architectural Forum*, presented a strong defense of the skyscraper against charges that it is anti-social, a white elephant and a cause of city congestion. Tall buildings, he said, relieve congestion, both vehicular and pedestrian, by taking horizontal traffic off the streets and converting it into vertical traffic within the buildings themselves.

On the economics of skyscrapers Wright reported that rental calculations on one skyscraper that has been losing money showed that a building of half its size would lose money even if fully occupied at double the present rent; whereas the tall building will be profitable when fully occupied. As to low buildings for large-scale office service he referred to the new government buildings at Washington: "Anyone who has trudged wearily through the miles of corridors of the Commerce or Labor buildings knows how badly suited such structures are to the administration of our complex society."

## Welded bridges

Bridge welding in Europe, discussed by Leon G. Rucquoi of Brussels, has developed much farther than in the United States, but has been both set back and subsequently further advanced by three failures, two in Germany and one in Belgium. The latter, a case of complete collapse, was not due to poor steel, he said, as a large number of tests has shown the steel to be soft, with low sulphur and phosphorus, ductility over 20 per cent, and impact and quenching tests good. Poor quality of welding may be responsible, he implied, as some of the welds were found to lack penetration.

As to steel quality for welded work, Rucquoi said that at present it seems best to hold to low carbon, highly ductile steel; later it may be feasible to return to higher strength and to low alloy steels, as is already being done in Germany.

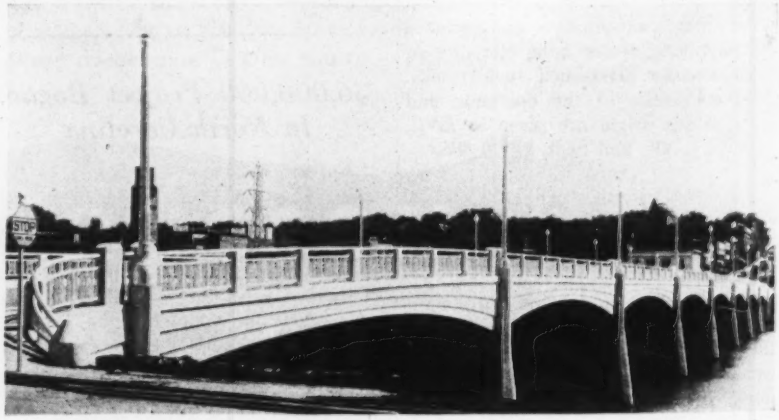
Ductility of steel also was a major theme of a paper by Prof. J. A. Van den Broek (Univ. of Michigan). Van den Broek referred to the so-called theory of limit design and explained its application to indeterminate structures. Transmission tower design has been particularly benefitted by the use of practice corresponding to this theory, and the Canadian Bridge Co. has verified the correctness of the reasoning involved by many load tests on full-size towers.

## Safer highways

Paul G. Hoffman, Studebaker Corp., stated that "The modernizing of our street and highway facilities is a tremendous undertaking that will cost not less than 25 billion dollars to provide the 25,000 miles of superhighways we need outside the cities, and at least another 25 billion to make a good start toward modernizing street facilities within our cities. Street and highway construction and reconstruction is the biggest new industry on the horizon."

Mr. Hoffman gave a survey of the work accomplished by the Automotive Safety Foundation in reducing highway accidents—from 17.4 fatalities in 100 million vehicle miles in 1935 to 16.4 in 1936, 15.9 in 1937, 12.9 in 1938 and 10.9 in the first six months of 1939, a saving of 29,000 lives in four years and a reduction of a billion dollars in cash loss. Present hopes are for a reduction to no more than 6 within five years.

Clyde G. Conley, Mt. Vernon Bridge Co., Mt. Vernon, Ohio, was reelected president of the Institute for the coming year. Clyde MacCornack, Phoenix Bridge Works, Phoenixville, Pa., was elected first vice-president, and Edward K. Klingelhofer, Pittsburgh, second vice-president.



**NEW ABRAHAM LINCOLN BRIDGE DEDICATED AT DIXON, ILL.**

EARLY THIS MONTH the $315,000 streamlined Abraham Lincoln Memorial Bridge over the Rock River at Dixon, Ill., was dedicated. Built entirely with state funds by the Illinois State Highway Department, the structure is 738 ft. long and provides a 44-ft. roadway between two 6-ft. sidewalks. It replaces an old structure on U. S. Highway 30.

The contractor was the Shappert Engineering Co., Belvidere, Ill., of which Frederick W. Shappert is head. Ernst Lieberman is chief highway engineer and C. F. Burch bridge engineer for the Illinois State Highway Department.

## Chicago Charges Fraud In Activated-Sludge Case

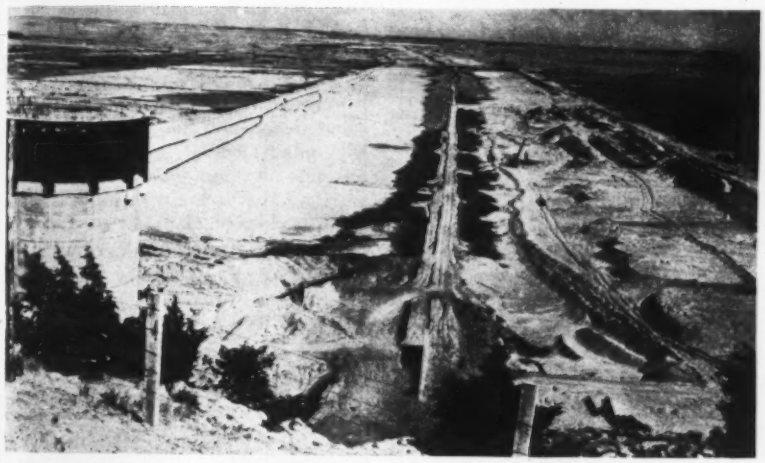
Reopening of the suit of the Sanitary District of Chicago over the use of the patented activated-sludge process is sought in a petition to the Circuit Court of Appeals by the district. The suit brought by Activated Sludge, Inc., owners of the patents, was decided in its favor in 1937 on the score of infringement of the patents held valid. The present petition to set aside the decree is based on recent evidence indicating fraud in the original suit.

According to the petition, Albert W. Dilling, chief engineer of the district from 1920 to 1922, supervised the installation of the activated-sludge process in two of Chicago's treatment plants and recommended its adoption for 180-mgd North Side plant. Dilling then quit the district, it is said, acquired a secret interest in the patent rights, after which he secretly fostered the suit to collect infringement penalties. Dilling denies that there was any secrecy.

## Pittsburgh Seeks Funds For New Water System

The mayor of Pittsburgh, recently, asked permission of the city council to issue bonds for the construction of a new water system for the city, estimated cost of the work being between $70,000,000 and $105,000,000. Two ordinances have been put before the city council at the mayor's request, one giving the mayor and the city's controller authority to issue bonds in accordance with a special act of the legislature and the other designed to give the mayor and the public works director authority to enter into contract with a New York banking house for issuing bonds to finance the improvement.

The present water supply of about 100,000,000 gpd is taken from the Allegheny River. The new supply would be a gravity system drawn from the northwestern part of the state. This source could be developed to supply 500,000,000 gpd.



**KINGSLEY DAM STARTS CORE-POOL OPERATIONS**

With 3,000,000 cu.yd. of fill in place by the middle of September in Kingsley Dam of the Central Nebraska Public Power and Irrigation District, on the North Platte River near Ogallala, Neb., the Minneapolis Dredging Co. Martin Wunderlich Co., contractors, have set up a schedule calling for the pumping by two 30-in. electric dredges of 1,800,000 yd. a month into the dam to permit storage of water to start in advance of Nov. 1, 1940, the date stipulated in license granted by Federal Power Commission. The A. H. Read Co., Cheyenne, Wyo., holds the contract to manufacture and install 981,000 precast concrete rip-rap units to be placed on the face of the dam.

On Sept. 14, when the above photograph was taken, fill had progressed to a stage permitting core-pool operations to begin. Total fill in the dam amounts to about 26,000,000 cu.yd. The control tower, morning-glory spillway, conduits and stilling basin are practically complete. Capacity of the reservoir at the top of the steel spillway gates will be 2,000,000 acre-ft., and the dam will be high enough to hold back an additional 500,000 acre-ft. with freeboard in an emergency.

George E. Johnson, Hastings, Neb., is chief engineer and general manager for the Central Nebraska Public Power and Irrigation District. At Kingsley Dam, George N. Carter is resident engineer, representing the district, and George P. Leonard is general superintendent for the Minneapolis Dredging Co.-Martin Wunderlich Co. K. Sewell Wingfield is chief PWA project engineer for Nebraska and Harry S. Mahood is acting as chief PWA resident engineer inspector.

## Fleming Becomes Wage-Hour Head

**Replaces Andrews in Washington; reason for change remains unknown**

R. B. Colborn
*Washington Office, ENR*

Lieut. Colonel Philip B. Fleming, assigned last week to handle the administration of the federal wages and hours law, is no stranger to New Deal agencies. As assistant administrator of PWA, from 1933 to 1935, he had charge of all personnel problems of that agency and was responsible for enforcement of PWA's own wage and hour rules. He was then put in charge of the Passamaquoddy tidal-power project, and in 1937 was called on, as coordinator, to settle the tangled affairs of the Resettlement Administration. Lately he has been district engineer at St. Paul.

### *Acts under nominal head*

Technically, Col. Fleming has merely been assigned to assist the acting wage-hour administrator, since the law forbids appointment of an officer to a civilian post without Congressional authority, but there is no question that he will be in full charge. Reason for dismissal of Elmer F. Andrews is something of a mystery in Washington. Commonest guesses are that he failed to defer sufficiently to Secretary of Labor Perkins and that organized labor felt he had been too easy-going in his enforcement of the law. Clear evidence of a general shift in policy is seen in the resignation of several subordinate officers of the wage-hour administration. However, Fleming's first official statement when he came to Washington was that he, not the Secretary would run the agency.

### *Known as diplomat*

Not at all the hard-boiled soldier, Col. Fleming is known for his suavity and diplomatic skill. He has never taken any part in politics, but his viewpoint is understood to be liberal. He graduated from West Point, first in his class, in 1911. Since the war his principal assignments have been educational, as instructor at the Camp Humphreys Engineer School, as one of the board preparing engineer training regulations, and, from 1926 to 1933, at West Point. There he was post engineer and water supply officer, senior instructor of military engineering—and one of the most successful football coaches the academy ever had. Fleming was sent to Eastport to head up the Passamaquoddy project when the chief need of that ill-fated undertaking was a diplomat.

## Building Inquiry

(Continued from p. 31)

to laborer—in various specialized fields such as plumbing.

Plumbing is one of the first subjects to be investigated in Cleveland. Although details, of course, are secret, it is understood the jury is being told that contractors have bid collusively and boycotted certain manufacturers; that unions have restricted output of members, boycotted shop-fabricated materials, enforced unnecessarily expensive methods, and conspired with contractors to maintain prices; and that certain manufacturers and dealers have conspired to boycott other manufacturers.

Similar charges are being made against the glaziers, and it is understood that the tile, cement, painting, excavating, and plastering fields will be investigated.

Resembling but not forming a part of this general offensive, is the grand jury investigation of inter-union jurisdictional disputes in the District of Columbia which began last week. An intermittent dispute between the teamsters and the operating engineers over transit-mix trucks has seriously delayed construction in Washington during the past summer, and the Justice Department asserts that this is illegally in restraint of trade. Although the Sherman Act exempts unions, the department takes the position that the exemption applies only to activities aimed directly at the benefit of their members—and that jurisdictional disputes do not fall in this class.

## George E. Beggs to Head Engineering Foundation

Prof. George E. Beggs, heads of the civil engineering department at Princeton University, has been named chairman of the Engineering Foundation, the research organization of national engineering societies. Beggs has been a member of the Princeton faculty since 1914.

O. E. Buckley, executive vice-president of Bell Telephone Laboratories, was named vice-president. Otis E. Hovey has been reelected director.

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## 100-Mi. Canal Considered For San Joaquin System

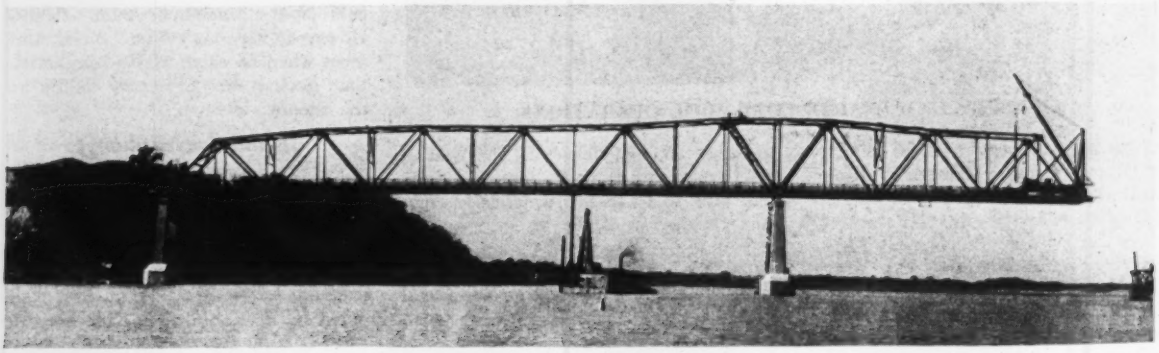
A west side high line canal extending from the vicinity of Stockton in San Joaquin County to Mendota in western Fresno County, a distance of 100 miles, has been adopted as the route of the San Joaquin pumping system, a major feature of the Central Valley project in California. The selection was made after an intensive two-year investigation of several alternative locations, and Chief Engineer R. F. Walter of the Bureau of Reclamation, has ordered that final surveys now be confined to such a line.

The purpose of the San Joaquin pumping system is to furnish substitute water from the delta to crop lands in the northern San Joaquin Valley. This will permit storage of a large of part of the San Joaquin River supply at Friant Dam.

## Federal Body To Control North Canadian River Flow

The United States Department of the Interior has asserted its power to control distribution of three-fourths of the annual flow of the North Canadian River and tributaries in Oklahoma for the next three years, according to Don McBride, director of the Oklahoma State Planning and Resources Board. The Interior Department's action follows the complaint of 70 individuals contesting Oklahoma City's claim of the right to use most of the annual flow of the stream for water supply purposes. By letter to McBride the department explains that its claim was based partly upon an amended statute which had been on the books since territorial days.

In the letter the department claims all unappropriated water in the river and superseded state authority to parcel out the water to various cities. This has had three immediate effects. Namely, (1) it threw into confusion an impending final adjudication of water rights in the stream which were to be decided Oct. 26 in a suit in the Oklahoma county district court; (2) it projected the probability that all claimants to water in the stream would have to obtain federal government permission to exercise their claims to water beyond that actually being used; and (3) it clouded plans for an Oklahoma City water project now proceeding on the theory that the city would be allowed 167,000 acre-ft. of the 202,000 acre-ft. of the river's annual flow.



**SHORTENING THE ROUTE BETWEEN CHICAGO AND DENVER**

RAPID PROGRESS is being made on a new Missouri River bridge at Brownville, Neb., which will provide a link in a highway through the northern tier of Missouri counties and the southern tier of Nebraska counties. This highway affords the shortest route between Chicago and Denver. Built by Atchison County, Mo., with revenue bonds and a PWA grant, the bridge consists of a two-span 840 ft. continuous truss and I-beam approach spans that bring the total length to 1,904 ft. Designed by Ash-Howard-Needles & Tammen, consulting engineers, of Kansas City, the bridge is particularly notable for a new type of pier design in which loads are carried by sheet piling riveted to H-section piles driven to bedrock and inclosing a core of overburden. This pier design will be described in an *ENR* article in the near future.

In the view shown above the 55-ton traveler with 75-ft. boom and 15-ft. extension is 210 ft. beyond the center pier; preparing to set a piece of falsework weighing 14 tons on the next pier 70 ft. beyond the end of the steel. C. F. Lytle Co., Sioux City, in substructure contractor and Bethlehem Steel Co. superstructure contractor. H. J. Bernat is resident engineer for the consulting engineers.

## Next E.C.P.D. Meeting To be in Pittsburgh

Pittsburgh will be the location of next year's meeting of the Engineers Council for Professional Development, it was decided at the annual meeting of that group in New York last week. This will be the first time an E.C.P.D. meeting has been held outside of New York.

J. P. H. Perry, vice president of the Turner Construction Co., was re-elected chairman of the council. R. E. Doherty continues as vice chairman, C. E. Davies is secretary and George Seabury, assistant secretary. The United Engineering Trustees, Inc., continues as treasurer. Committee chairmen are as follows: A. A. Potter, engineering schools; R. L. Sackett, student selection and guidance; C. F. Scott, professional recognition; O. W. Eshbach, professional training.

In a report of the committee on professional recognition it was stated that of the men added to the professional grades by the engineering societies in 1938 the following per cents had been registered by state boards: Am. Soc. C. E. 50 per cent; A.I.E.E. 33 per cent; A.S.M.E. 25 per cent; A.I.Ch.E. 16 per cent; A.I.M.E. 12 per cent. The council's next report on accredited schools will be made public Nov. 1.

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## Long Super Toll Roads Impractical, Says Fairbank

Long-distance toll highway projects are foredoomed, H. S. Fairbank of the Public Roads Administration told delegates to the Interstate Conference on Automotive Taxation recently in New York. He based his statement on traffic surveys which show that trips of 100 mi. or more compose only 2 per cent of all trips. One-way trips of 30 mi. or less make up from 88 to 93 per cent of all trips. Failure of such roads would occur "because of the competition of reasonably adequate free highways," he said.

Road tax diversion and state line trade barriers were also discussed.

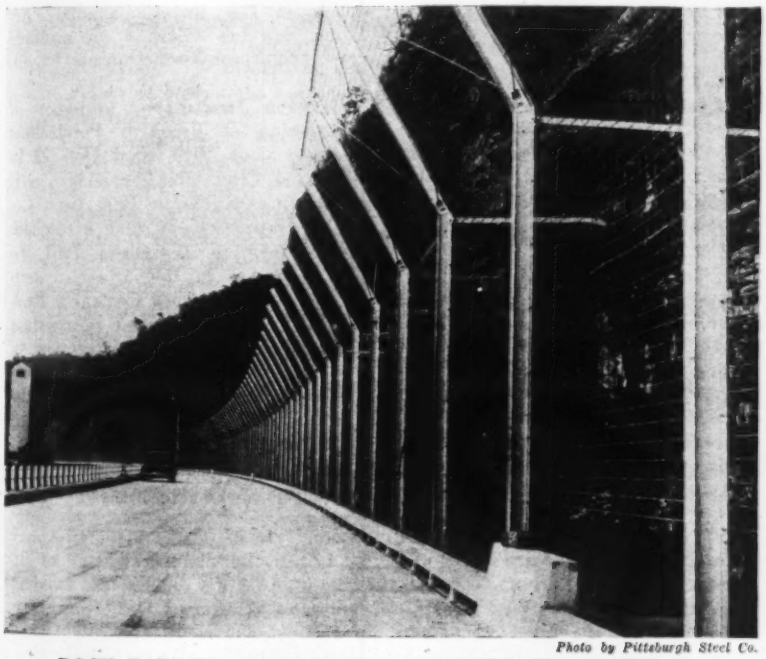

*Photo by Pittsburgh Steel Co.*

**ROCK BARRIER ON IMPROVED PENNSYLVANIA HIGHWAY**

WHEN State Route No. 906, between Monesson, Pa., and Webster, Pa., was widened recently a specially designed rock barrier rising 23 ft. above the pavement was erected to protect traffic from falling rock. A total of 3,435 ft. of barrier was erected with the anchorages grouted into holes in the rock cliffs. Panel lengths are 90 ft., with springs at panel joints to absorb the shock from falling stones.

Need for the barrier arose when the highway was widened from 16 ft. to 24 ft., a track of the Pittsburgh and Lake Erie R.R. limiting roadway width on the outer side. The work was done by the Tri-State Engineering Co., Cumberland, Md., which improved 2.4 miles at a cost of $243,000, for the Pennsylvania State Highway Department. Ray Beckner supervised the work for the contractor and A. E. McNabb, an engineer with the Pittsburgh Steel Co., assisted in the design of the barrier.

## Toll Bridge Group Studies War Problems

Problems that might face toll bridge operators in the event of war occupied the attention of the board of directors of the American Toll Bridge Association when it met in Washington this week. Bridges being an early target of bombardment, the operators are worried as to whether they will have to stand the loss. Although war risk insurance is available, such policies can be revised with the outbreak of war and seem to offer little protection. Representatives at the meeting gave some consideration to group insurance for bridges. However, no conclusions were reached.

Another potential war problem considered was whether the Army would have to pay tolls. Courts have held that tolls must be paid in peacetime. But what the wartime situation would be no one knows.

The directors heard a report on two recent collisions of ships with bridges. The St. George Bridge, which was struck this spring by a government boat, is being re-built by the War Department, and the case of the Norfolk Bridge, which was struck by a privately-owned freighter, is still in the courts, it was pointed out.

Formation of an organization of ferry companies affiliated to A.T.B.A. was also discussed. It was decided to hold the Toll Bridge Association convention in Atlantic City Feb. 4–6. John W. Beretta of San Antonio, Texas, continues as president of the organization.

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## Last Concrete Poured On Colorado Aqueduct

Representatives of Los Angeles and 12 other nearby cities met Oct. 14 at San Jacinto, Calif. to celebrate the placing of the last yard of concrete for the Colorado River aqueduct being built for the Metropolitan Water District of Southern California to carry water from Parker Dam on the Colorado River across 242 miles of desert and mountains to the Caljalco storage reservoir. Some time next year the entire distribution system, a $200,000,000 project, will be placed in operation for supplying the 1,000,000 gpd to the 13 cities of the district.

In addition to witnessing the placing of the last concrete, members of the metropolitan water district board of directors unveiled a bronze plaque commemorating completion of the work. They also sealed into the concrete a copper box containing records of the district's work and the names of the 35,000 workers employed in building the aqueduct.

# OBITUARY

ARCHIBALD F. RADER, 68, president of the Belmont Iron Works, died Oct. 8 at Haverford, Pa. After graduating from the University of West Virginia, Rader joined the Lassig Bridge Co. and worked with that firm until 1901 when he resigned to join the Belmont Iron Works. In 1936 he became president of the organization.

GEORGE H. M'LEAN, 63, chief of the Rhode Island State Division of Rivers and Harbors, died Oct. 21 in Providence, R.I. For 24 years M'Lean was employed by the A. Williams Sperry Engineering & Construction Co., New Haven, Conn., at one time acting as general manager and treasurer. The Yale Bowl at New Haven was built by the Sperry firm under M'Lean's direction.

LESLIE A. STEMMONS, 62, graduate of the University of Chicago, died Oct. 15 at Dallas, Tex. Stemmons had played an important part in formulating a city plan for Dallas and in getting the Houston St. viaduct built in that city.

HENRY C. ANDERSON, dean of the University of Michigan College of Engineering, died Oct. 14 in Ann Arbor, Mich. at the age of 66. Anderson graduated from the University of Kentucky in 1897 and began his engineering career with the Cincinnati, New Orleans, Texas & Pacific R.R. He joined the University of Michigan faculty in 1899 and became associate professor in 1903, a junior professor in 1906 and full professor in 1912. He headed the department of mechanical engineering for 20 years before becoming dean of the engineering college in 1937.

CHARLES SACRA, 45, member of the firm of Sacra & Watts, contractors, died Oct. 17 in Denver. In 1894 he received a civil engineering degree from the University of Indiana and started in the construction field in Colorado in 1924. He engaged in highway work in Colorado for a number of years and in 1932 organized the firm of Sacra & Watts.

JOHN MONKS, JR., until 1932 president of John Monks & Son, New York City contractors, died Oct. 17 at the age of 76. He succeeded his father as head of the firm when the latter was appointed dock commissioner at New York. Monks retired in 1928.

NOAH H. SULOFF, engineer in charge of construction of the Cleveland Union Terminal, died Oct. 21 at the age of 70. Following his graduation from Pennsylvania State College in 1891, Suloff joined the Pennsylvania R.R. to do construction work. For two years he was with the Altoona & Phillipsburg Connecting R.R., Phillipsburg, Pa. and spent one year on construction with the Tuscarora R.R. He became assistant chief engineer with the Cleveland Union Terminals Co. in 1911.

THOMAS A. GILKEY, engineer for Lawrence County, Pa., for more than 30 years, died in New Castle, Pa., Oct. 16. Gilkey graduated from Pennsylvania State College with a civil engineering degree in 1894 and spent the next year with the Youngstown Bridge Co., leaving that firm to join the Marshall Structural Works, Pittsburgh, Pa. He also worked for a time with the Pittsburgh Bridge Co. and Shiffler Bridge Co. In 1908 he started his work as engineer for Lawrence County.

ALEXANDER M. MACGREGOR, railway construction contractor of New Glasgow, Nova Scotia, died Oct. 19 in New Glasgow at the age of 75. MacGregor was a former member of the Canadian Parliament.

ROBERT T. TAYLOR, 55, civil engineer and superintendent of the Tacoma division of the Northern Pacific R.R. since 1934, died Oct. 14 in Tacoma, Wash.

THOMAS C. LEONARD, 74, retired contractor of Spokane, Wash., died in that city Oct. 14.

JOSEPH C. LASKER, 68, pioneer contractor of Lewiston, Idaho, died there Oct. 17. Lasker had been engaged in building in Lewiston for 37 years, having retired recently.

GEORGE W. LOVEBERRY, retired contractor of Seattle, Wash., died in that city Oct. 19 at the age of 72.

JOHN C. MICHIE, 77, superintendent of the Durham, N.C. city water department, died in Durham Oct. 18. Michie graduated from Virginia Military Institute in 1887 with a degree in civil engineering. Subsequently he was employed by the Norfolk & Western Railway, and was placed in charge of construction on the old Lynchburg and Durham line. Subsequently he went into private practice as a consulting engineer and in 1892 became superintendent of the Durham city waterworks, continuing to act as superintendent when the waterworks was bought by the city.

CAPT. JAMES M. YOUNG, 43, a graduate of West Point in 1918, died recently at Fort Belvoir, Va. Young directed much of the work in developing the upper Missouri River, being with the Omaha District, U.S. Engineers, from 1933 until 1937. For a time he acted as district engineer of Kansas City office. In 1936 he went to Fort Belvoir.

A. E. WARREN, 65, vice-president of the Canadian National Ry. and in charge of the Western Lines, died in Winnipeg, Man., Oct. 16. Warren had also served as general manager of the Grand Trunk Pacific Ry. He was soon to be transferred overseas.

E. WORTH KOLB, 68, manager of commercial inspection and tests for the General Railway Signal Co., died Oct. 18 in Rochester, N.Y. Following his graduation from the University of Purdue in 1895, with a civil engineering degree, Kolb worked for a time with the Union Pacific R.R. and in 1908 joined the Chicago, Rock Island & Pacific R. R. He joined the signal company 12 years ago.

HORACE K. CORBETT, civil engineering graduate from the University of New Brunswick in 1938 and pilot officer in the Royal Canadian Air Force, met his death in an airplane crash near Snow Road, Ont. on Oct. 14.

GERARDO IMMEDIATO, professor of engineering at Brooklyn Polytechnic Institute since 1919, died Oct. 22 in New York City. After receiving a civil engineering degree in 1900 from Columbia University and then a mechanical engineering degree in 1901, he was employed in the bridge department of the New York Central & Hudson R.R. Later he worked as assistant engineer on railroad construction in Peru. In 1904 he became assistant engineer for the Rapid Transit Commission New York City. He also worked for a time in Mexico for the Mexican Light & Power Co. on tunnels, dams, and power house construction.

Other recent deaths include: ALTON L. LOGAN, building contractor of St. Louis; THOMAS J. TOBIN, 83, building contractor of Ottawa, Ont.; SAM GRAHAM, 56, contractor of Philadelphia, Miss.; GEORGE L. WALKER, 69, retired civil engineer of Kansas City, Kan.; ARTHUR C. CARSON, 79, retired engineer of San Francisco, Calif.; FRANK F. HACKETT, 75, contractor and inspector for the Pioneer Pole & Shaft Co., in Memphis, Tenn.; H. ALFRED JANKE, 66, engineer of Plainfield, N.J.; FRANK C. BLESDOE, 61, Arizona State Highway Commission, in Cleveland, Ohio; LOUIS DEGRIEF ZELLNER, 54, construction engineer of Cincinnati, Ohio, in Dayton, Ohio; and MATHEW M. MCCUNE, 50, retired engineer of Salt Lake City, Utah.

## *Early Panama Work To Be On Cost-Plus Basis*

The Panama Canal preliminary construction work will be done under a cost-plus-fixed-fee basis, according to an announcement from Edward J. Harding, managing director of the Associated General Contractors.

Interested contractors, singly or in combination, should submit their full qualifications to the Quartermaster General, War Department, Washington, by Nov. 7 for consideration. One requirement is ability to handle a minimum contract of $9,000,000.

Construction includes building barracks, machine shops, warehouses, post exchange and post offices, hangars, communications building, repair shops and laundry. The program now being started is estimated to cost $40,000,000.

# CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week, $64,263,000, are 20 per cent higher than in the corresponding week last year. This week's volume brings 1939 construction awards to $2,510,314,000, 12.3 per cent above the $2,235,658,000 for the 43-week period a year ago.

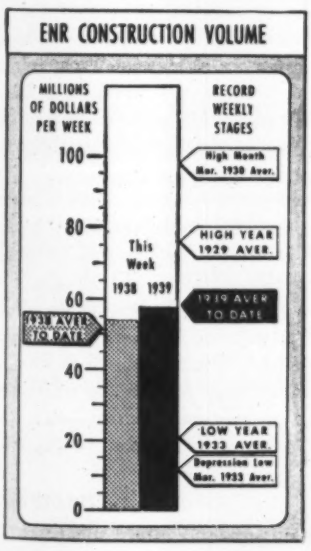
Private awards for the week top a year ago by 156 per cent, the seventh consecutive week that they have exceeded their respective 1938 values, and the second successive week that private volume provides the bulk of new construction. Private construction to date totals $717,533,000, an increase of 3 per cent over the corresponding period last year.

Public construction for the week is 26 per cent lower than in the 1938 week.

Two large utility projects, one each in North Carolina and Pennsylvania, and a steel plant modernization project in California, are responsible for bringing industrial building construction to its second highest week of the year. In addition to industrial buildings, commercial building and large-scale private housing, streets and roads, and unclassified top their respective volumes of a year ago; and waterworks, bridges, public buildings, streets and roads, and unclassified exceed their totals for the short preceding week.

New capital for construction purposes for the week totals $3,703,000. This compares with $60,718,000 for the corresponding week in 1938. The current week's financing is made up of $3,700,000 in state and municipal bonds, and $3,000 in RFC loans for public improvements.

New construction financing for the year to date, $2,233,426,000, is 33 per cent below the $3,352,450,000 reported for the initial 43-week period last year.




### CONTRACTS

(Thousands of dollars)

| | Week Ending Oct. 27 1938 | Oct. 19 1939 | Oct. 26 1939 |
|---|---|---|---|
| Federal | $5,282 | $16,099 | $3,987 |
| State & Municipal | 34,946 | 22,436 | 25,966 |
| Total public... | $40,228 | $38,535 | $29,953 |
| Total private.. | 13,406 | 17,693 | 34,310 |
| TOTALS | $53,634 | $56,228 | $64,263 |
| Cumulative 1939 (43 weeks) | | | $2,510,314 |
| 1938 (43 weeks) | | | $2,235,658 |

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

### NEW PRODUCTIVE CAPITAL

| | Cumulative 1938 43 Wk. | 1939 43 Wk. |
|---|---|---|
| NON-FEDERAL | $2,208,805 | $1,105,398 |
| Corp. securities | 335,581 | 185,341 |
| State & Mun. | 513,976 | 434,365 |
| R.E.A. loans | 58,009 | 89,445 |
| R.F.C. loans | 100,128 | 4,600 |
| P.W.A. allot. | 767,189 | ..... |
| U.S.H.A. loans | 232,422 | 201,647 |
| Fed. Aid—Hwys. | 201,500 | 190,000 |
| FEDERAL | $1,143,645 | $1,128,028 |
| TOTAL CAPITAL... | $3,352,450 | $2,233,426 |

### FHA MORTGAGES

| | Week Ending Oct. 22 1938 | Oct. 14 1939 | Oct. 21 1939 |
|---|---|---|---|
| Selected for appraisal | $24,504 | $21,666 | $23,342* |
| Cumulative 1939 (42 weeks) | | | $944,127* |
| 1938 (43 weeks) | | | $828,126 |

* Subject to revision.

### ENR INDEX NUMBERS

| Index Base | | 1913 | 1926 |
|---|---|---|---|
| Construction Cost | Oct. | 236.86 | 113.87 |
| Building Cost | Oct. | 198.50 | 107.31 |
| Volume | Sept. | 190 | 83 |

## *Chicago Disposal Progress Cited*

**Recognition given to sanitation district at Central States Sewage Works Association meeting**

To give added recognition to the fifteenth anniversary of the formation of the Sanitary District of Chicago, which was the first organization of its kind in this country, the Central States Sewage Works Association held its twelfth annual meeting in Chicago Oct. 12 and 13. Emphasis was placed on the progress of sewage disposal in Chicago where the largest plant yet built, the Southwest 400-mgd plant, is just now entering routine service. This marks the end of a period of aggressive sanitary activity during which the city has moved from last place to first in the matter of sanitary protection of its water supply, having spent $125,000,000 on dilution measures and $163,000,000 on artificial treatment.

### *Sludge disposal symposium*

Included in the program of the association, which with its 501 members is the second largest of the 25 affiliates in the Federation of Sewage Works Associations, was a session on sludge disposal in which filtration and incineration at Buffalo and the Twin Cities and the flash drying system at Chicago (*ENR* Oct. 27, 1938, p. 524) were covered.

Now that Chicago has all of its sewage under treatment, the Illinois State Board of Health has moved forward rapidly with its clean-up program of the Illinois River watershed, according to C. W. Klassen, chief sanitary engineer. He stated that 110 of the 130 cities on the tributaries have treatment projects in some stage of progress. By the end of this year industrial plants in this area (exclusive of Chicago) with a waste equivalent to a population of 2,000,000 will have reduced their wastes 85 per cent. Cooperation between sanitary authorities and industry without recourse to legal regulations has been the means by which these ends have been achieved.

### *Officers elected*

Newly elected officers to the association were president, B. A. Poole; vice presidents, C. C. Larson, G. W. Martin and K. L. Mick; secretary-treasurer, W. H. Wisely, Springfield, Ill.; representative to the Federation Board of Control, W. W. DeBerard. J. L. Ferebee is holdover representative. A summary of the sludge disposal symposium will be published in a forthcoming issue.

# COMMENT AND DISCUSSION

*Readers' opinions on matters that concern the engineer*

## Concrete Bond Strength

Sir: In reference to the article "Computing Bond Stress in Unequal Bar Layouts" by Roy E. McFee (*ENR*, Jan. 19, 1939) I would like to bring before you a formula we use here at the University of Toronto, to determine the bond stress on a rod in a reinforced-concrete beam using two or more different sizes of rods.

Consider a beam having three different sized round rods for the tension steel. Required the unit bond stress on each rod at a section where the shear $= V$.

If rod diameters are $D_1$, $D_2$, and $D_3$ and corresponding unit bond stresses are $U_1$, $U_2$, and $U_3$

$$\frac{U_2}{U_1}=\frac{D_2}{D_1} \text{ and } U_2 = U_1 \frac{D_2}{D_1}$$

$$\text{also } U_3 = U_1 \frac{D_3}{D_1}$$

$$\text{The average bond stress} = U = \frac{V}{\Sigma ojd}$$

$$\text{Then } U\pi\Sigma D = U_1\pi D_1 + U_2\pi D_2 + U_3\pi D_3$$

$$U\Sigma D = \frac{U_1 D_1^2}{D_1} + \frac{U_1 D_2^2}{D_1} + \frac{U_1 D_3^2}{D_1}$$

$$\therefore U\Sigma D = \frac{U_1 \Sigma D^2}{D_1}$$

$$\text{and } U_1 = \frac{U\Sigma D}{\Sigma D^2} \cdot D_1 = \frac{V}{\Sigma ojd} \cdot \frac{\Sigma D}{\Sigma D^2} \cdot D_1$$

$$\text{also } U_2 = \frac{V}{\Sigma ojd} \cdot \frac{\Sigma D}{\Sigma D^2} \cdot D_2$$

$$\text{and } U_3 = \frac{V}{\Sigma ojd} \cdot \frac{\Sigma D}{\Sigma D^2} \cdot D_3$$

W. J. SMITHER
*Associate Professor of Structural Engineering*
*University of Toronto*

## Thin Walls in Housing

Sir: The writer has been much interested in your articles on low-cost housing, the most recent on the Queensbridge Project in New York City (*ENR*, July 20, 1939, p. 78). Referring to this one in particular it appears that while the engineering authority has been able to reduce the per-room cost to a low figure, it has done this largely at the expense of good construction.

In section, one of these apartment buildings is shown to be essentially a six-story bearing-wall building 28 to 30 ft. in width and about 60 ft. in height from the first floor to the top of the parapet. A row of concrete columns in the center support a 5-in. flat slab built into the wall on each side. The wall in the four top stories is a combination of 4-in. brick and 8-in. load-bearing tile. The wall in the two lower stories is a 12-in. brick wall. The dead load unit-stress on this combination wall at the second-floor level, assuming a reasonable increment for partitions, is upwards of 500 lb. per sq. in., and at the first-floor level is in excess of 700 lb. per sq. in. This takes into consideration only the dead load; live load and high winds will add an alternate compression and tension on the masonry, perhaps equal to 10 per cent of the dead load.

The buildings are constructed in a section of the country where storms of hurricane violence are a distinct possibility, though not so much so as farther east along Long Island Sound. The danger in these storms is not the velocity of the wind and its consequent pressure on the side of the building, but the bursting pressure in rooms that may be closed caused by a sudden drop in the barometer. In the last storm of this nature that visited the coast of New England, Sept. 21, 1938, this expansive pressure assumed very formidable proportions and was the cause of most of the damage inflicted on buildings. A barometer change from 29 to 27½ in. might subject walls, floors and ceilings to an outward pressure of around 100 lb. per sq. ft. Two instances will illustrate the effect.

The second floor of a mill building was covered by a wood-frame roof of mill construction and surrounded by a brick wall. One row of wood columns at the center supported the roof. At the time of the change in barometric pressure the entire roof structure rose, cracking the masonry horizontally under the window lintels and carrying the brickwork above with the roof. The vertical displacement is estimated to have been 2 in. to 4 in. Some of the columns tipped out and fell to the floor. When the barometric pressure was equalized the roof settled back to its original position. The only damage evident was the small crack in the masonry and the columns that were lying on the floor.

A porch column having a 1½-in. pine shell was fitted with a tight 2-in. base and cap, the base secured to the floor and the cap to the soffit of a continuous lintel. The column had been kept well painted for a long time and was very nearly airtight. This building faced the southeast in an exposed position. Practically the only damage sustained was that two of the columns split on the centerline and the half-section of one was split off and blown 10 ft. or more while the half on the windward side remained in position. There was little other damage.

Brick buildings having 12-in. and 16-in. walls, two stories high, were wrecked in innumerable cases; in some cases the end walls of large buildings were blown out, leaving the roof undisturbed. There is unmistakable evidence all along the coast from New Haven, Conn., to Portland, Me., to show that masonry walls should be made heavier than in the past, that the floor systems should be carried on pilasters or columns, and that walls should be tied to the floor system. The use of membrane flashing through the wall should not be resorted to more than absolutely necessary, for it destroys the bond of the masonry and its ability to absorb shear. Walls 12 in. thick built of 4-in. brick and 8 in. of tile are seldom permitted for use as bearing walls except in one-story buildings. In the writer's experience such a wall is not equal to a 12-in. load-bearing hollow-tile wall. Unit stresses should not exceed 200 lb. per sq. in. of gross area.

In these housing projects it would seem that the walls are too thin and light in weight to function properly. When they crack and leak due to a combination of circumstances all related to this one deficiency an attempt is made to remedy the difficulty by changes in the floor slabs with additional membrane flashing, etc. This overlooks the real cause of the trouble.

G. L. BILDERBECK
*Groton, Conn.*

## The Waterworks Inventory

Many letters have been received commenting on the inventory of water supply facilities in the United States which was published as an insert in the Sept. 28 issue. Excerpts from some of the letters follow:

. . . You have made a very valuable contribution to statistical data in the water industry; the inventory supplies reliable information that has heretofore been a matter for the estimator to wrestle with. I consider this a distinct service for the waterworks man and worthy of more than passing commendation.

J. A. JENSEN
*President, American Water Works Association, New York, N. Y.*

. . . You are to be congratulated on this extensive and worthwhile job. Would it be possible to obtain copies of the table in order that we might send one to each of our groundwater field offices?

DAVID G. THOMPSON
*Senior Geologist, U. S. Geological Survey, Washington, D. C.*

. . . I desire to compliment you upon your success with the inventory. It has been concluded that the data included in your inventory of both the water supply facilities and the sewage disposal facilities (*ENR*, Jan. 19, 1939) are of such value that each member of the technical staff of the bureau of engineering should have a copy of both.

H. P. CROFT
*Chief Engineer, State Department of Health, Trenton, N. J.*

. . . *Engineering News-Record* has performed a signal service to the sanitary engineering profession in making surveys of water supply and sewage disposal facilities.

R. E. THOMPSON
*Toronto, Ont., Canada*

. . . You have rendered a valuable service to the waterworks and engineering industries in publishing this inventory. I endeavored unsuccessfully for a number of years to have some technical society assemble these data.

CHARLES HAYDOCK
*Consulting Engineer, Philadelphia, Pa.*

. . . We have found the information in your water and sewage disposal inventory very helpful, and we appreciate your courtesy in supplying reprints.

CECIL A. CARLISLE
*Publicity Manager, American Cast Iron Pipe Co., Birmingham, Ala.*

. . . I feel that you are justly proud of this joint service to sanitary engineers and we are glad to have this material available in our files.

GEORGE L. HALL
*Chief Engineer, Department of Health, Baltimore, Md.*

. . . We are happy to have this information and we feel that you are to be commended for the excellent work you have presented.

V. M. EHLERS
*Director, Bureau of Sanitary Engineering, Austin, Tex.*

. . . Congratulations! These data will be widely used.

WILLEM RUDOLFS
*Chief, Div. of Water and Sewage Research, N. J. Agricultural Experiment Station, New Brunswick, N. J.*

. . . This is a fine piece of work on the part of *Engineering News-Record* and I believe it will be quite useful. We are very glad to assist in compiling these records.

H. E. MOSES
*Chief Engineer, Department of Health, Harrisburg, Pennsylvania*

. . . This inventory is very comprehensive and contains much useful information.

RICHARD MESSER
*Director, Sanitary Engineering, Department of Health, Richmond, Va.*

## More About Spirals

Sir: I have read Professor Wiley's article in *ENR*, Sept. 14, 1939, and find myself in complete agreement with what Professor Wiley has written.

It is desirable that highway curves shall be arcs of circular curves because this greatly facilitates steering around the curves. Transitions at the ends of circular curves are necessary for two reasons: first, to enable the driver to adjust his steering from the tangent to the circular curve and vice versa; second, for a proper introduction of the super-elevation that is necessary on the curve.

When one reflects that the degree of curve at the point of curvature or tangency of a circular curve is exactly the same as at any other point on the curve, the following becomes evident: first, that if the driver of any vehicle is to avoid changing his position in the lane in which he is driving when he approaches the curve, he must make the correct turn of his steering wheel at the precise instant that he passes the point of curvature or tangency. This matter is important. If the driver approaching a curve is a little slow in turning his wheel, he may continue over into the opposing lane and cause a collision or continue off the pavement if he is slow in straightening out when he passes off the curve. The introduction of the spiral gives him a reasonable period in which to adjust his steering to the change from the straightaway to the circular curve and vice versa. Second, since the curvature is the same at the point of tangency as it is elsewhere on the curve, the super-elevation should be the same, but since this will amount to several inches, it is necessary to use a transition at the points of curvature and tangency.

Where no spiral is used, super-elevation is introduced by "fudging". If the spiral were used, it would be possible to increase the super-elevation along with an increase in the degree of curvature and thus provide a correct transition.

The only reason that can be imagined for not using spirals is that those who make the plans imagine that considerable complications and difficulties will arise from that use.

As one who has had considerable experience in running spiraled railroad alignment, using Professor A. N. Talbot's handbook, "The Railway Transition Spiral," I am in a position to state that the computations and instrument work involved in the use of this spiral do not increase the difficulty of calculating or running the alignment in any way. The tables in that book are ample to afford a considerable latitude in the choice of the length of the spiral to be used in any and all cases. I have not seen Professor Wiley's "Route Surveying" but have no doubt that the application of the tables in that publication to highway alignment will be no more difficult than is the use of Professor Talbot's tables.

M. W. TORKELSON
*Director of Regional Planning Wisconsin State Planning Board*

# ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

*OCTOBER 26, 1939*


NO BRANCH OF CONSTRUCTION has been more subject to changed conditions than building. Largely supported by private capital which seeks maximum economy plus buyer appeal, building has benefited from unusually intensive research that has made it a fertile field for new materials, new equipment and new methods. Since 1936 the volume of building has been working back toward substantial levels of expenditure, which this year will reach the neighborhood of 2.5 billion dollars. The combination of more new things plus more buildings gives engineers and architects enlarged opportunities to utilize their talents, and at the same time it increases their responsibility for keeping abreast of developments. To aid them in doing so, this issue contains a special section devoted to ten notable building projects of the year. Nearly every type of building is represented, and few readers will fail to find something new or suggestive in each.

## *A Specter Returns*

FORTY YEARS AGO a typhoid epidemic that caused half a hundred deaths would hardly have been big news; today the papers find in the news of 52 typhoid deaths at the Manteno, Ill., state hospital an occasion for special staff reports, and are keenly interested in how the tragedy could have happened. The four decades since the '90s brought so much progress in sanitary science and engineering that epidemic typhoid is a thing of the past and wholesale deaths such as those at Manteno can occur only through some exceptional chain of events or through direct negligence. At Manteno, typhoid germs have been found in the water of one of four wells that supply the hospital, a well 225 ft. deep and within 30 ft. of a sewer, in seamy limestone. And evidence of negligence appears in statements of the state health department that the hospital authorities had been warned of the pollution of the supply. On present incomplete evidence gross negligence appears to be responsible for the epidemic. The case gives grave warning of the need for vigilance and a sense of responsibility on the part of public and institutional authorities, lest the dread specter of the '90s return.

## *Obsolete Streets*

ANTIQUATED STREETS are forcing Washington to make costly improvements on some of its traffic circles. Grade separations are being built, not because traffic circles in themselves are unsatisfactory for traffic interchange but because the much-lauded street plan of Washington has become obsolete. The complicated system of diagonal streets has shown itself to be inefficient as to both land use and intercommunication, and is probably a large factor in bringing about Washington's abnormal traffic congestion. Thus, an important aspect of the present work is the revelation that a street system once satisfactory can be rendered obsolete by radical change in living habits and traffic. Similar obsolescence of street layout may be observed in other cities, and has already led to much thoroughfare construction; many more such improvements are likely to be needed soon.

## *Advanced Theory*

THE REPORT on widths of separating strips at intersections of divided highways, an essential part of which is summarized in the following pages, is the first authoritative examination into the rational design of this vital detail of the modern four-lane road. The report lays down the fundamental principles of design for traffic safety. Recognizing facts, it provides ways for compromise where physical and financial limitations present a barrier to free action. It is practical. To most designers probably the demonstration that a safety factor exists in the proper relationship of median strip width to length of opening, where roads cross, will be the newest thought and the one that is most dubiously accepted. It is to this theory therefore that most of the discussion in the following pages is devoted.

## *Skyscrapers*

AFTER THE BUILDING BOOM of the late '20s it became a popular pastime to decry skyscrapers as wasteful fads and creators of congestion. In actual experience, however, the skyscraper is probably the most efficient business aid that modern engineering has brought forth, and some calculations

cited by Henry Wright before the American Institute of Steel Construction last week indicate that within limits it is correspondingly economical. Mr. Wright also protested against the congestion charge, pointing out that, since skyscrapers reduce the need for horizontal transportation by providing vertical transportation, they lessen congestion instead of making it greater. Complaints against the skyscraper on the score of congestion are really complaints against the tendency of people to crowd together closely in cities; but the problems that grow out of this intrinsic city congestion are quite unrelated to building height. On present showing it is reasonable to conclude that the skyscraper is not at all a thing of the past.

## Toll Road Study Needed

EVIDENCE that the toll road is a major question facing public roads administrations came prominently to the front at the meeting two weeks ago of the American Association of State Highway Officials. Leading speakers took a strong stand against the new development. Their thought deserves attention. Coupled with continued diversion of motor-vehicle taxes to non-highway uses, the increasing trend toward toll charges to finance highway facilities presents a disquieting outlook. It is time that toll road problems should receive authoritative study.

These problems are not simple. To assert positively that tolls have no place in the American road system would be just as indefensible as to say that tolls should be charged wherever there is lack of money and stress of traffic. There is need of sound determination of the right course. It is not enough to rest on the doctrine of free roads for a free people. That would be to ignore actualities.

Traffic imperatively requires many roads, bridges and associated facilities that cannot be quickly enough provided by the depleted funds now available. The toll road or bridge is the way out, and it is the way that is being taken—and will continue to be taken until a better way is found. The facts are irresistible. But the danger is that the easy way of the toll road will be too often taken.

The remedy lies in careful determination of the place—if it has a place—of the toll road in a free-road system. Obviously the road user should not lightly be asked to pay a toll beyond his present road-service charges. Can such additional charge always be avoided? If not, when is it justified? If it can be avoided, what is the best procedure?

Such questions are complex, and involve many problems of transport policy, finance, administrative control and engineering procedure. The answer should be sought by a special committee of the Association of State Highway Officials, such a committee as the one that in this issue lays down principles for divided highway design. There can be no more important task for public highway officials to undertake.

## Pollution Control

NEW YORK AND NEW JERSEY entered into a compact about four years ago that set up the Interstate Sanitation Commission to work for the reduction of pollution of the waters of the New York metropolitan district. The commission is a regulatory body having power to classify the water of the district as to use and to prescribe standards of purity to be maintained. It has the power to take court action against municipalities that disregard its orders. Now a movement has been started to expand the commission's powers to give it authority to finance and build sewage disposal facilities for communities that cannot now raise funds to build such facilities because they are too near their debt limit. The bonds of the commission would be secured by sewer rentals.

On superficial examination this proposed amplification of the commission's powers may seem desirable, but more thorough examination will show the proposal to be fundamentally unsound. Its major defect is that it would destroy one of the safeguards of our system of government; the proposed amendment to the acts setting up the commission would give the commission the power to *build* the very plants that it *orders* to be built. The opportunities for abuse in such a set-up are obvious.

There appears to be no reason for attempting such a combination of regulatory and executive functions. New York and New Jersey could provide for sewer-rental revenue financing more easily than they could change the interstate compact that set up the commission. Further, any attempt to grant what may be unconstitutional powers to the commission might end in destroying the commission and in nullifying the good work it already has accomplished. Its pioneer work for interstate sanitation should not be jeopardized by a short-sighted attempt to convert it into a financing and constructing agency.

FIG. 1. THOMAS CIRCLE JUST AS CONSTRUCTION WAS BEGUN ON THE MASSACHUSETTS AVE. UNDERPASS.

# Washington Revises Its Famous Circles

H. C. WHITEHURST

Director of Highways, Washington, D. C.

***Contents in Brief—Redesign of circle intersections in Washington has begun because they have developed into major traffic obstacles. Reconstruction now under way at Thomas Circle and plans for Scott and DuPont circles being made.***

WHEN L'ENFANT laid down for the nation's capital his famous system of diagonal avenues on a checkerboard system of streets, he solved the multiple intersection problem by traffic circles. Today these circles have become traffic obstacles and a major reconstruction operation is necessary on many of them if traffic is to be reasonably well served. To tell something of the reconstruction needs and plans is the purpose of the description and illustrations that follow.

### General plan is simple

It was not until well after the advent of the automobile that any thought was given to the movement of traffic about Washington's circular intersections. Since that time, rules have been adopted providing that all traffic shall move into the circles to the right; thus they have become one-way routes with the traffic moving counter-clockwise. This helps the situation, but it does not solve it, because the roadways in most of the circles are too narrow and the intersecting streets too close together to permit proper weaving of the traffic and to care for all of the traffic. It is generally conceded by highway and traffic engineers that the roadway in the circles should provide for one-quarter as many traffic lanes as the total free lanes of traffic which enter the circle from all intersecting streets, provided that the maximum number of lanes does not exceed six.

The plan is to redesign the circles by introducing grade separations and divided roadways. The present plan includes the redesign of three circles: Dupont Circle, a 10-point intersection; Thomas Circle, an 8-point intersection, and Scott Circle, a 6-point intersection (Fig. 3). It is interesting to note that at each of the three traffic circles mentioned, Massachusetts Ave. is involved. Massachusetts Ave. is the through northwest to southeast street; and, being the longest avenue, it has the greatest number of intersection or feeder streets of any thoroughfare in the city. Considering the fact that home development in the northwest section of the city is progressing rapidly, and that the traffic volume will continue to increase on this avenue, it seems evident that the problem at these respective circles involves a separation of directional traffic flows, to be accomplished by redesigning the circles and the constructing underpasses.

### Thomas Circle begun

Funds were made available by Congress in 1939 for the construction of an underpass and the redesign of Thomas Circle. Work at this location is now in progress and the project is

scheduled for completion in November of this year.

Thomas Circle, the intersection of 14th St., Massachusetts Ave., Vermont Ave. and M St., is one of the most congested in Washington. Fig. 1 shows the original appearance of this circle, the traffic facilities of which, it may be noted, consisted only of a 50-ft. roadway for carrying east-west vehicular as well as north-south vehicular and trolley traffic around the circle. The congestion may be appreciated when it is noted that the eight streets entering and leaving the circle have a combined width of 420 ft. and further that about 46,000 vehicles of all types enter the circle each day.

Surveys revealed the present traffic volume on Massachusetts Ave. to about equal that on 14th St. but to be increasing on Massachusetts Ave. However, since both of the streets (13th and 15th) parallel to and on each side of 14th St. have been widened, and therefore tend to relieve 14th St. traffic conditions; and further, since the right-of-way width of 14th St. was not sufficient to permit the construction of an adequate-width underpass for both the street railway tracks and vehicles, and at the same time leave sufficient space for surface roadways on 14th St. to serve the abutting property, it was decided to construct the underpass in line with Massachusetts Ave., which has a right-of-way of 160 ft., and to carry 14th St. through the circle, using the roadway around the circle for other streets entering this area, as well as providing means of transferring traffic from one street to another. The new design provides for: (1) two 37-ft. roadways for through north-south traffic; (2) two 39-ft. feeder roadways; (3) two 21-ft. roadways for east-west underpass traffic in line with Massachusetts Ave.; (4) two 19-ft. east-west surface roadways, and (5) a 19-ft. roadway for Highland Terrace.

Fig. 2. The three circular intersections on densely built up Massachusetts Ave. that are planned for reconstruction.

The Highland Terrace roadway referred to illustrates the difficulty of changing original grades in municipal construction. Some years ago it was decided to change the existing grade of Massachusetts Ave. between 14th and 15th streets and to do so it was necessary to construct an auxiliary roadway on the north side to serve those residences already there which were of considerable value. Due to maintenance of this investment it has been necessary to retain this auxiliary road (Highland Terrace) with a roadway some 10 ft. above the grade of Massachusetts Ave.

It is estimated that the construction of this underpass together with the surface streamlining to be accomplished will double the traffic capacity at this intersection and thereby relieve traffic congestion.

The underpass is 420 ft. long, and is of the twin tunnel type with 6 per cent grade approaches of about 300 ft. One of the problems in planning for this underpass was the care of various utilities occupying this area. There were ten utilities including telephone, sewer, street car, gas, water, electric, telegraph, police con-

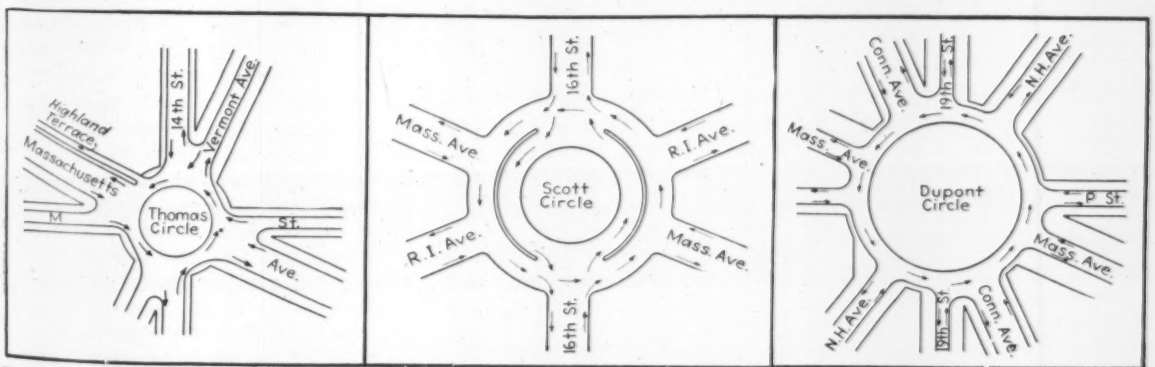



Fig. 3. The three famous Massachusetts Ave. circles that are to be reconstructed to reduce traffic congestion and delays.

trol, fire alarms, etc., which had to be considered. All of these were moved by the utility companies except the water mains and sewer, the changes for which were included in the general contract.

Due to the importance of this focal point, definite provision was made in the contract requiring the contractor to follow a schedule of work that would permit of continuous travel over the streets and cause a minimum of inconvenience to the public. A description of the construction operations will be given in a future article.

### Dupont Circle plans

There are five streets intersecting at Dupont Circle with about 53,000 vehicles of all types utilizing this area every 24 hours. The combined width of the ten streets entering the circle is 504 ft., and the present width of the main roadway around the circle into which this traffic flows is but 45 ft. The traffic problem is further complicated by the presence of car tracks carrying trolleys running in a direction opposite to vehicular traffic flow.

The plan that has been developed provides for a grade separation for through traffic on Connecticut Ave., but at the same time retains ample roadway capacity to serve the abutting property, and to allow Connecticut Ave. traffic to transfer to other streets entering the circle. The roadway around the circle will be slightly widened by the reduction of the inner sidewalk width. Further, the roadway will be divided into two parts to permit through Massachusetts Ave. traffic on the inner roadway. This arrangement will make possible the placing of Massachusetts Ave. on the flexible progressive lighting system, so that traffic can move straight through, as on any light-controlled street. In other words, Massachusetts Ave. at the entering and exit points, becomes a simple intersection. The outer roadway of the circle will be used for all other entering streets, and for the transfer of traffic from any street entering the circle area to any street leaving the circle area.

### Scott Circle Changes

Scott Circle is a 6-point intersection where three main thoroughfares constitute the streets entering the area. These three streets each carry from 2,000 to 3,000 vehicles during the rush hours. As may be noted from Fig. 3 this circle is developed on the split-circle plan. However, due to the radii of curbs, and the rather small diameter, circle traffic is difficult to handle. Serious consideration is being given to underpassing 16th St. traffic and streamlining the circle to facilitate the flow of east-west traffic as a solution of this problem. In this case the result will be to make a simple intersection with light control of Massachusetts Ave. and Rhode Island Ave., with 16th St. passing under the oval formed by the intersection of the east and west streets.

### Traffic survey begun

The projects referred to are in demand to provide for the care of existing traffic; however, the district highway department is endeavoring to take into consideration future demands in the design of all structures and roads that are being constructed, and in the planning and designing of its highway program. A cooperative highway planning survey has been arranged with the Public Roads Administration. The engineer department of the district has endeavored to keep informed as to changing traffic count and conditions but the value of a thorough and correlated traffic survey, taking into account all conditions incident to and affecting traffic, is fully appreciated. This survey will permit of a rational estimate as to future needs and will assist the department engineers in proper planning and designing for an economical and satisfactory street system for the nation's capital.

# Designing Stormwater Inlets For Greatest Efficiency

THE EFFICIENCY of storm drainage facilities is no greater than that of the inlets which are provided to pass water into the underground piping, according to W. E. Rosengarten, engineer, Lower Merion Township, Ardmore, Pa. In a paper at the American Public Works Association conference he cited the following design considerations:

Inlet openings should be spaced at 300 to 500-ft. intervals, depending on the width and grade of the road surface. At corners it is better that the inlet be placed on the tangent adjoining the corners rather than in the middle of the curve.

The inlet box should not be smaller in size than 18 in. wide and 4 ft. in length. This is the minimum to accommodate a man and to operate pipe cleaning equipment. Weep holes are essential on the road side of the box at elevations slightly below the subgrade of the road so that water may be readily removed from the low points.

The mouth of the inlet should preferably be fitted with an apron of brick placed on edge or of concrete. The slope of this apron should be about one inch in four toward the box. The inlet mouth should not be over 7 in. in height in order to keep children out. On grades of more than 5 per cent grates are desirable in front of the open mouth; a preferred design for the grate is one in which the bars are placed at an angle of 45 deg. so as to divert the maximum amount of water into the inlet.

Inlet covers may vary in shape but the circular cover is most desirable since it will not fall through its frame as will the square or oblong covers.

The outlet pipe from a box should be funnelled in order to increase the pipe capacity; a sharp edged opening acts as an orifice and the necking of the stream makes it impossible to have the pipe flow to capacity. The mouth of the outlet pipe should be about 50 per cent larger than the diameter of the main pipe.

Since the purpose of the stormwater inlet is to reserve and pass water rapidly into conduits, particular attention should be given to elimination of all sharp angles, corners and pockets.

# Building Settlement Checked Successfully

WALTER H. WHEELER
Consulting Engineer, Minneapolis, Minn.

***Contents in Brief—Continuing settlement of a large school building was successfully checked by installation of an underground framework carried on steel bearing piles outside the building walls.***

SETTLEMENT of the Dunwoody Industrial Institute building in Minneapolis was noticed soon after the building was completed in 1923 and various methods for reinforcing the foundations were undertaken at intervals thereafter, but these remedial works were only partially successful. The settlement was particularly bad in the east wing where the administrative offices and a large assembly room are located. By 1938 the condition of this wing had become so serious that it was recognized that major reinforcement of the foundations would be necessary to save the building.

The basement walls of the building are of reinforced concrete; above the basement are solid brick bearing walls, which support the reinforced concrete floor system and the steel roof trusses. The floor girders run crosswise of the building and support one-way tile and joist floor slabs. Interior columns are of reinforced concrete. Footings for the columns and walls were supported on composite piles of concrete and timber. To form these piles, steel shells were driven to a depth of about 40 ft. and then a wooden pile was driven through the shell until it had penetrated 30 to 35 ft. below the bottom of the shell, to give a pile depth of about 70 ft. The shell was then filled with concrete and withdrawn.

When the writer examined the building in 1938 it was found that some of the reinforcement that had been put in after the building began to settle was holding but in other places settlement continued so that in some places there was a foot or more of wood blocking between the pile cap and the bottom of the wall. All the east wing columns were being supported on sets of 4 jacks each and these were being turned up at the rate of about $\frac{1}{8}$ to $\frac{1}{4}$ in. per month. Some of the interior footings had settled about 2 ft. The floors of the building had a slope from the rear to the front of about 7 in.

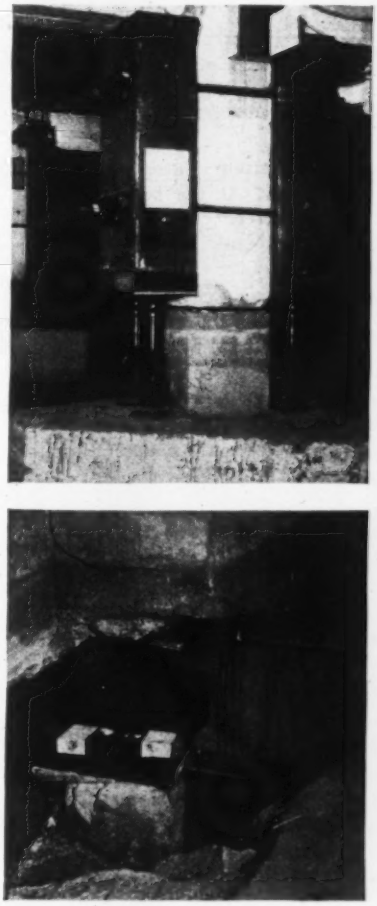


**Fig. 1.** The jacking arrangement to compensate for continuing settlement of the old foundations is shown at the top. Below is shown the temporary blocking on top of one of the old piles to support the wall while the new work was being placed.

After studying the situation it was decided not to attempt to level up the building, but merely to support it and stop the foundation settlement.

The plan adopted involved driving six clusters of six each of 14-in. steel-bearing piles to refusal outside of the building as close to the walls as it was practical to drive them, install cross girders supported on these pile clusters and transfer the bulk of the weight of the building to the girder systems.

The eaves of the building had a very wide overhang. In order to work as closely as possible under this cornice the pile driver was rigged with adjustable leads. The driving was done with a 5,500-lb. steam hammer working on a 3½-ft. stroke, estimated to deliver at least 15,000 ft.-lb. per blow. The piles were bought in 37-ft. lengths and the ends were milled and drilled for splicing in the shop. A special cast steel follower block was used which prevented the ends of the piles from being battered in driving. Splice plates were bolted with lock nuts. The piles were driven to an average depth of about 100 ft. below cutoff, the deepest going 114 ft. 4 in. Cutoff was about 3 ft. below water level and about 10 ft. below basement floor level so that these piles went an average of about 40 ft. deeper than the wood and concrete piles that were used in the construction of the building.

The structural drawings and specifications described the design and suggested general methods for executing the work. This was done on the theory that the engineer had spent considerable time in planning and designing the work and in his study necessarily had given consideration to practical methods of execution. It was desired to let the job on a lump sum basis and it was felt that if practical methods for executing the work were suggested to the bidders it would assist them in making up their bids. The work was done under a lump sum contract and executed along the lines which the engineer had suggested.

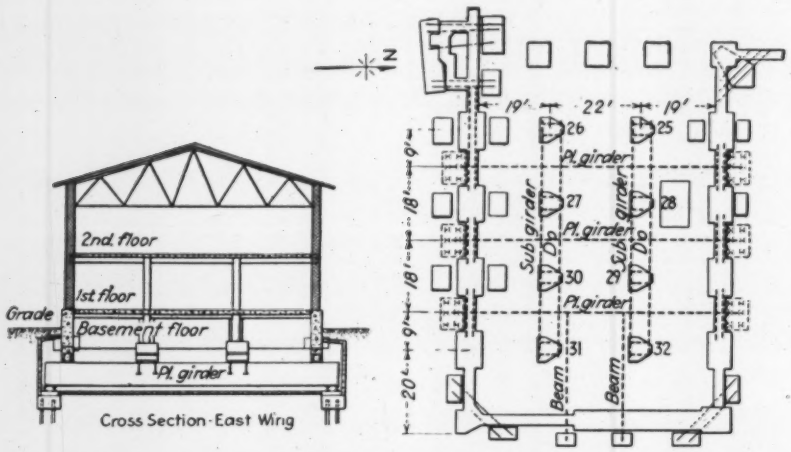



**Fig. 2.** Plan and section through the east wing of the institute building where the worst settlement occurred. The original foundations and early reinforcement are shown in full lines, the new work in heavy dotted lines.

The three main girders, which weigh about 22 tons each, were fabricated complete at the shop and delivered to the job by trailer truck. They were rolled off the truck endwise and under the building in trenches that had been previously prepared and then turned up into the proper position, blocked up and then lowered onto the grillages after they had been set. Sub-girders were then moved in through the same trenches and erected in the trenches that had been prepared for them. When these were in place short cross beams were set under the column footings and the tops were bedded in mortar against the bottom of the old footings. Steel shims were driven between the top of the sub-girders and the bottoms of these beams to bring them up to a full and tight bearing under the old footings.

The entire weight of the east wing is now supported on the new framework, except northeasterly and southeasterly corners and along the line of the connection with the main building on the west. At these points reinforcements previously installed under the exterior walls seem to have resisted settlement in a satisfactory manner, and the amount of the settlement at interior columns did not seem to justify expensive reinforcements at this time. The two concrete footings outside of the east wall used to support the ends of new steel beams are supported on steel pipe piles. These were also part of a previous reinforcing system which had resisted settlement.

Inside the building the girders are enclosed in open trenches with 3-in. treated sheetpile sides, and treated plank floors. At the basement floor level these trenches are covered with loose 2-in. plank to form the basement floor over the trenches. The space between trenches was brought to grade by filling with a mixture of clay and cinders wet and rolled in. Outside the building, the ends of the girders are enclosed in waterproofed, reinforced concrete chambers which are supported on the concrete foundations that cap the steel piles. There is ample space to walk in the trenches on both sides of the girders. Thus they can be opened for inspection at any time, and can be kept painted and preserved indefinitely. The clay and cinder floor for the basement and also the wood trenches were adopted in preference to reinforced concrete because of the continual settlement of the ground under the building. The ground all around the building, particularly on the front, is continually settling so that it is necessary to place new fill from time to time to maintain the grade.

During the progress of the new work, the old piles were used as far as possible to support the building. By frequent blocking and wedging it was possible to do this so that very little other shoring was required. All of the concrete girders were badly cracked where they joined the columns in the basement. To support the girders the columns were built out on the sides from the footings to the under side of the girders.

During the whole progress of the work levels were taken daily and if settlement was noted jacking, wedging and shoring was done at once so that in the whole operation there was practically no settlement of the building. In placing the longitudinal steel beams under the outside walls and on top of the steel girders, two 100-ton jacks were used to seat the beams under the walls, and the spaces between the tops of the girders and the bottoms of the beams were then filled

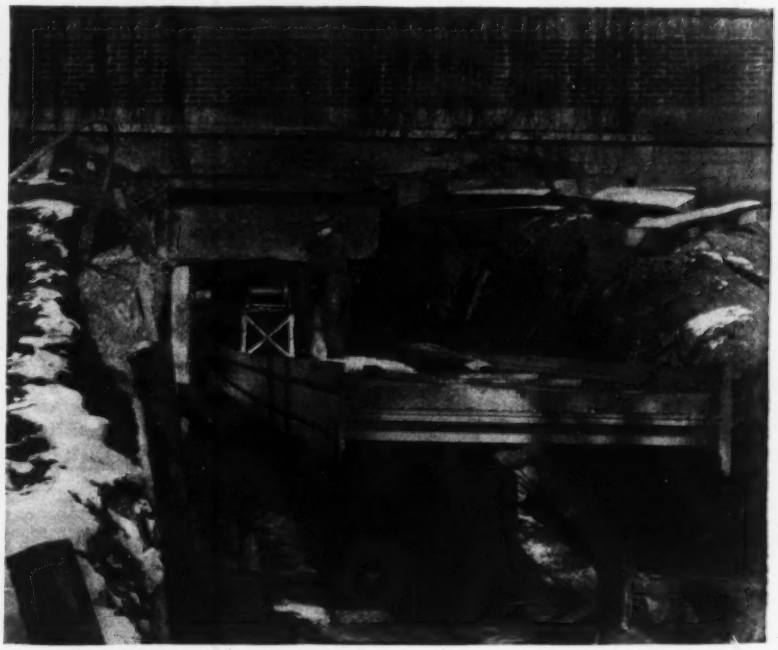


**Fig. 3.** The main girders were laid flat and rolled under the building.

with steel plates. This operation closed up longitudinal cracks that had developed in the walls. At some points the beams were raised as much as 2 in. off the girders with the jacks.

As a matter of precaution the major portion of the office force was moved into one of the other adjoining buildings while the work of placing the girders and footing supports was going on and the assembly room was used as little as possible. However, the contractor executed his work so skillfully that practically no plaster was cracked in the building. Seven months after the work was completed check levels were run from a fixed benchmark and these showed that there had been no movement.

The work was executed by the Industrial Contracting Co. of Minneapolis. The writer prepared the plans and specifications and supervised the work.

# Small Earthfill Dam Typical of Modern Practice

FOLLOWING THE FAILURE of the Fruit Growers Dam, an earthfill structure in Colorado, during a flood in June, 1937 (*ENR*, June 24, 1937, p. 932) the farm and irrigation interests affected began negotiations for the construction of a new dam by the U. S. Reclamation Bureau. The new structure, completed in December, 1938, is an example of many smaller dams of this type. It is located 450 ft. downstream from the old site on Alfalfa Run, a tributary of the Gunnison River, near Delta, Colo. As described by Stephen H. Poe in "The Reclamation Era", it is 55 ft. high, with a crest length of 1,250 ft. and a maximum base width of 330 ft. Its reservoir will have a storage capacity of 4,580 acre-ft. to serve farms and orchards on an area of 2,600 acres, but with the present spillway crest elevation the capacity is only 2,540 acre-ft.

The old dam, built in 1898 by local irrigation interests, had its height increased as additional land went into cultivation so that at the time of failure it was nearly 40 ft. high. Much of its material was shale, placed dry and without sufficient compaction, hence it was very porous and became unstable when saturated. Its spillway capacity was very limited.

Failure began with a slip at the downstream toe, burying the outlet, and water flowed from a break 14 ft. below the crest. After a futile attempt to cut a channel in the spillway had been made the dam was cut at the north end to prevent a sudden collapse, thus reducing the peak of the discharge of the entire contents of the reservoir.

In cross-section, the new dam has a slope of 1 on 3 for the upstream face, while the downstream face slopes 1 on 2 from the crest, El. 5,493, to El. 5,450, and thence 1 on 6 to the toe. Earth and gravel excavated from borrowpits by two dragline machines was hauled to place by motor trucks of 2 to 5-cu.yd. capacity, a fleet of 14 trucks being required with both excavators at work. Material dumped in winrows lengthwise of the dam was spread to a loose thickness of 8 to 9 in. by a bulldozer, after which all oversize stone was removed by hand. Each layer was compacted to 6 in. by a tractor-hauled triple-drum sheepsfoot roller, an average of 12 trips giving the required density of 109.7 lb. per cu.ft. Around the concrete spillway and conduit, the material was placed by hand in 6-in. layers and compacted by 80-lb. pneumatic paving breakers equipped with tamping feet.

Moisture content was controlled by selection at the pits, the ground being kept damp by seepage from irrigated land and the average condition being 18.1 per cent of moisture. Sprinkling on the fill was rarely necessary. Below a silty topsoil there was a bed of sand and gravel 2 to 12 ft. thick, underlaid by a clayey material. Mixing the material in the pits by the excavators resulted in a very homogeneous fill. In general, the finer material was placed in the central upstream portion and the cutoff trench, and then graded to coarser material at the slopes.

Rock riprap on the upstream face, obtained from scattered surface rock and rockpiles in cleared fields, was kept 15 to 20 ft. below the top of the fill during construction. For the base, the original surface was stripped down to a bed of firm earth. Most of the material in the old dam was unsuitable for use and was removed to give a free flow to the new outlet. A cutoff trench 1,380 ft. long was excavated 35 ft. upstream from the centerline of the dam. Its depth averaged 10 ft., but depended on the materials encountered. While the minimum bottom width was 8 ft., much of it was 12 to 14 ft. wide, to facilitate placing the fill, which consisted of a larger proportion of clay, with some sand and gravel, 45 per cent passing the 200-mesh screen. Drains at the downstream toe consist of sewer pipe laid with open joints in a bed of screened gravel in a trench 3 ft. deep and located 10 ft. back from the toe. Work on the dam was carried on in three shifts of 6 hours 40 min.

An open-crest concrete spillway, crest El. 5,480, but with provision for raising to El. 5,485, discharges to a channel tapering from 12 to 20 ft. in width and 5 to 16 ft. in depth. The stilling basin has a concrete portion 20 x 40 ft. and 17 ft. deep, with dentated sills, below which is a dredged pool 20 x 45 ft., with 2 ft. of heavy rock riprap on the slopes. A reinforced-concrete outlet conduit leads from a trash rack to the gate chamber and thence to the stilling box, chute and stilling basin. Collars on the conduit prevent percolation along the outer face of the conduit. Flow through the outlet is controlled by two 24-in. slide gates, one of which is for emergency use. A 6-ft. shaft gives access to the gate chamber and has at the top a hand hoist to operate the main gate.

This project was designed and carried out under the direction of R. F. Walter, chief engineer, U. S. Bureau of Reclamation, and construction was done by government forces in order to save the time required for advertising and letting the work by contract. Riprap work was done by the CCC. An allotment of $200,000 was made under the Emergency Relief Appropriation Act of 1937, and the actual cost was approximately $149,500.

MEDIAN STRIP ON THE PHILADELPHIA ROAD NEAR BUSH RIVER, MD.

# Median Strips at Highway Intersections

***Contents in Brief**—Increasing use of median strips on four-lane highways has brought with it new design problems at intersections. Basic requirements affecting such design work, as set forth in a report to the American Association of State Highway Officials, are given.*

ADVANCED highway-design opinion is agreed that safety lies in giving such dense and fast traffic as a four-lane road implies independent roadways for opposing currents of moving vehicles. The separating or median strip which keeps the two roadways apart introduces a new design problem. At present, there is no settled practice or opinion. To lead to both, a committee of the American Association of State Highway Officials known as the special committee on administrative design policies presented to the executive committee at the meeting held at Washington, D. C., last week an analysis of median-strip design at intersections that ranks with the most important of technical studies in highway engineering.

The volume of the committee report permits of only a brief summary, and this is confined to median-strip width: (1) safe width for left and U-turns where right-of-way allows reasonable limits of choice and (2) design of openings for safe turns where median strips are limited in width.

## Basic assumptions

For this discussion three characters of traffic are considered: *P* denotes traffic exclusively of passenger vehicles or including so little truck travel that it has small effect on passenger-vehicle movement; *T* denotes traffic in which the percentage and character of truck movement is such that the speed of passenger vehicles is reduced and the passing of slower vehicles is frequent; *M* denotes mixed traffic in which slow-moving vehicles impede traffic only occasionally.

The design vehicles assumed are shown by Fig. 1; they are not average or inclusive of all types that are manufactured, but a design based on these vehicles accommodates almost all vehicles manufactured. For *P* traffic, *a* shows the assumed vehicle and the path of its sharpest left turn; *b* gives the corresponding data for truck or bus (*T* traffic) the requirements for which are not appreciably different from the standpoint of geometric highway design; for *M* traffic, the assumptions are the same as for *T* traffic, Fig. 1*b*. Based on traffic counts of the planning survey (*ENR*, June 2 and 9, 1938) it is assumed that semi-trailers longer than 30 ft. should not influence highway design. Since the semi-trailer has a shorter turning radius than the design truck (Fig. 1*b*) the net effect on design for a left turn is to require a slightly wider turning zone. On the basis of these assumptions the minimum width of median strips at intersections to provide protection for crossing vehicles is 19 ft. for *P* traffic and 30 ft. for *T* traffic. The lane width is 11 ft.

## Design for left turns

*Turns to Divided Highways*—This condition assumes a start from a protected position on the median strip to make a left turn onto the divided highway. For *P* type traffic the minimum design is shown by Fig. 2*a*. End clearances of 18 in. are afforded the vehicle in the median zone. Wider openings in the median strip up to

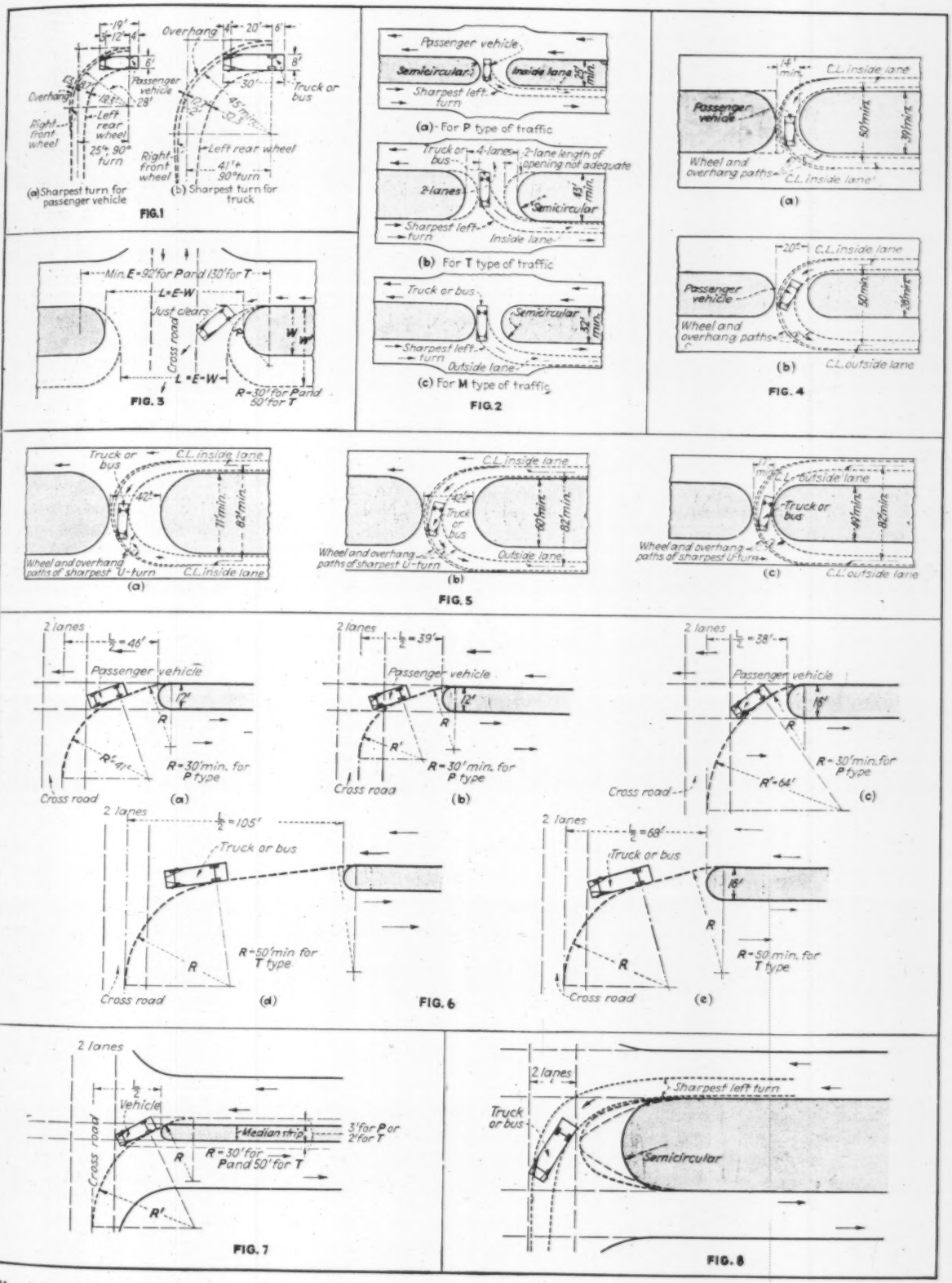



Fig. 1-8. **Limiting factors in designing width of median strip for safe left and U-turns at divided highway intersections and relation between width and length of opening for safe turning.**

four lanes give space for two cars abreast and more room to maneuver in turning. Still wider openings encourage dangerous fast turning. If desirable and practicable to provide median strip storage space for two vehicles in line, the width of the median strip should be increased 25 ft., that is the length of the assumed passenger vehicle plus 6 ft. of clearance space.

Fig. 2*b* shows the corresponding design for the assumed truck. End clearances are in this case 1 ft. A two-lane opening in the median strip is inadequate and a four-lane opening allows the truck barely to get by and not encroach on an adjacent lane. For two trucks in line, an additional median-strip width of 35 ft. is required. This gives each truck 5 ft. of clearance space. For mixed traffic type *M*, a compromise design, Fig. 2*c*, is suggested; this gives clearance for a truck but requires it to swing onto the outside lane in turning.

*Turns from Divided Highway*—A vehicle turning left from a divided highway should clear the inner lane as promptly as possible. That it may do so in the presence of cross-traffic the opening in the median strip should be long enough for the vehicle in a stopped position to clear the traffic lanes on both the cross-road and the divided highway as shown in Fig. 3.

The inner wheel paths of the turning vehicles actually are transitional; equivalent circular arcs, however, may be used with little error. The minimum radii which accommodate the transitional turns of vehicles are 30 ft. for *P* traffic and 50 ft. for *T* traffic. For convenience it is assumed that the equivalent circular arc for the path of the inner rear wheel is tangent to the inner edge of the inside lane. This allows some leeway in that a vehicle may turn on slightly easier curvature when the wheel is a foot or two clear of the edge of pavement.

The minimum length of opening is obtained by assuming the minimum radius for the wheel path from the inner lane of the divided highway to the stopped position of the vehicle clear of all traffic lanes as shown in Fig. 3. The path of the vehicle from the stopped position to the crossroad does not affect the required length of opening. The minimum length, *E*, Fig. 3, is 92 ft. for *P* traffic and 130 ft. for *T* traffic. The length of opening *L* between semicircular ends of the median strip is equal to $E - W$ in which *W* is the width of median strip. Since *E* is the controlling minimum distance, minimum lengths of opening are smaller for wider median strips. The desired widths of median strip for left turns onto divided highway (Fig. 2) are 25 ft. for *P* traffic, 32 ft. for *M* traffic and 43 ft. for *T* traffic. The corresponding desirable lengths of opening between semicircular ends of median strip are 67, 98 and 87 ft. respectively. If the median strips are only wide enough to protect crossing vehicles, i.e., 19 ft. for *P* traffic and 30 ft. for *M* and *T* traffic, the desirable lengths of opening between semicircular ends are 73 ft. and 100 ft., respectively.

Shorter lengths of opening than those shown above result from assuming that a left-turning vehicle in its stopped position encroaches on the inner lane of the divided highway to the extent of 3 ft. for *P* traffic and 2 ft. for *T* traffic, and that the turn is begun from a point 3 ft. from the inner edge of pavement in the case of *P* traffic and 2 ft. in the case of *T* traffic. The lengths of opening resulting from these assumptions are in the nature of compromise lengths but they afford reasonable protection to left-turning vehicles. The *E* distance varies slightly but may be assumed constant with little error. The *E* distance is about 75 ft. for *P* traffic and 110 ft. for *T* traffic. The compromise lengths of opening for the desirable widths of median strips, therefore, are 50 ft., 78 ft., and 67 ft. for *P*, *M*, and *T* traffic, respectively, and the compromise lengths of opening for median strips 19 ft. wide for *P* traffic and 30 ft. wide for *M* and *T* traffic are 56 ft. and 80 ft. respectively.

*U-Turns*—U-turns, if possible, should be from inside to inside lane. The minimum design for type *P* traffic is shown by Fig. 4*a*. The 14-ft. median lane opening suffices but a wider opening is desirable for operating leeway and for occasional truck turns. To restrict turns to one-direction traffic the shape of one end of the median strip may be changed as shown by the dash line Fig. 4*a*. Where right-of-way limitation requires a median strip narrower than 39 ft., the design Fig. 4*b* is suggested with the turn from the inside to the outside lane. This arrangement cuts down the width 11 ft.

Three designs of U-turns for the assumed truck are indicated by Fig. 5. Design *a* is for the preferable route from inside to inside lanes; designs *b* and *c* show means of reducing the median strip width where right-of-way is restricted. These designs and those of Fig. 4 are for U-turns separate from intersections.

### Openings for narrow strips

Narrow median strips are considered to be those less than 19 ft. wide for *P* type of traffic and less than about 30 ft. wide for *T* type of traffic. Ordinarily they do not afford complete protection to vehicles crossing the divided highway or to vehicles making left turns through short openings. If, however, openings are long enough protection is afforded vehicles making left turns in the manner shown in Figs. 6 and 7. Minimum lengths of opening in narrow median strips are developed for two cases. In Case I it is assumed that openings are long enough to enable vehicles making left turns to rest in the median area clear of through traffic lanes. In Case II it is assumed that openings are long enough to enable vehicles making left turns to rest in the median area by encroaching on each adjoining traffic lane of the divided highway to the extent of 3 ft. for *P* type of traffic and 2 ft. for *T* type of traffic.

*Case I.*—It is assumed that the design vehicle in its protected position in the median area is just clear of the edges of the through traffic lanes, as shown in Fig. 6. The minimum radii of the passenger vehicle and the truck are assumed to be 30 and 50 ft., respectively. The various factors which determine the minimum lengths of opening in median strips are shown in Fig. 6, using widths of 12 and 16 ft. as examples. The factors are similar for other widths of median strip. Those shown are for left-turning vehicles leaving the divided highway. For vehicles left-turning onto the divided highway the required lengths of opening are slightly longer.

In some cases two minimum lengths of opening are considered. In one the vehicle in its stopped position clears the traffic lanes of the divided highway but does not clear the cross-traffic lanes. This is illustrated in Fig. 6*b*. In the other the vehicle in a protected position clears all traffic lanes as in Fig. 6*a*. The former requires the sharpest practicable turning radius and results in a shorter length of opening than the latter. In some cases

as illustrated in Fig. 6e the minimum radius of turn must be utilized in turning to or from the protected position clear of all traffic lanes so that no choice regarding clearance of cross traffic is presented.

*Case II.*—The assumptions and factors which determine the length of opening for this case are the same as those for Case I except in two particulars. In one the design vehicle in its stopped position in the median area does not entirely clear the through traffic lanes of the divided highway but encroaches to the extent of 3 ft. for *P* type of traffic and 2 ft. for *T* type of traffic. In the other the path of the rear inner wheel of the design vehicle is assumed to be tangent to a line drawn parallel to the inside edge of the through-traffic lane of the divided highway but offset from that edge 3 ft. and 2 ft. respectively. This case is illustrated in Fig. 7.

The openings resulting from the assumptions in Case II are much shorter than those in Case I and they, therefore, are in the nature of compromise lengths. The lengths of opening for Case II, however, afford reasonable protection to left-turning vehicles and may be used where, for various reasons, it may be inexpedient, impracticable or undesirable to use the longer lengths of Case I.

The minimum lengths of opening for various widths of narrow median strip are shown in the accompanying table. Two columns are shown under each case, that under the subheading (1) being for the assumption of protection clear of all traffic lanes, and that under the subheading (2) being for the assumption of protection clear of through-traffic lanes on the divided highway only, but not on the cross-road except where the lengths under both subheadings are the same, particularly for narrow median strips.

**LENGTHS OF OPENING FOR NARROW MEDIAN STRIPS**

**(All values in feet)**

| Width of median strip | P type of traffic | | | | T type of traffic | | | |
|---|---|---|---|---|---|---|---|---|
| | Case I: Protected turn | | Case II: Compromise | | Case I: Protected turn | | Case II. Compromise | |
| | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| 4 | ... | ... | 84 | 77 | ... | ... | ... | ... |
| 6 | ... | ... | 72 | 57 | ... | ... | 275 | 275 |
| 8 | 168 | 168 | 64 | 52 | ... | ... | 177 | 177 |
| 10 | 111 | 104 | 59 | 50 | 333 | 333 | 138 | 138 |
| 12 | 94 | 80 | 56 | 48 | 209 | 209 | 113 | 113 |
| 14 | 83 | 62 | 55 | 46 | 163 | 163 | 102 | 93 |
| 16 | 77 | 48 | 54 | 44 | 136 | 135 | 95 | 84 |
| 18 | 74 | 42 | 54 | 42 | 124 | 117 | 89 | 82 |
| 20 | ... | ... | .. | .. | 116 | 102 | 85 | 80 |
| 22 | ... | ... | .. | .. | 111 | 89 | 83 | 78 |
| 24 | ... | ... | .. | .. | 107 | 78 | 82 | 76 |
| 26 | ... | ... | .. | .. | 104 | 74 | 80 | 74 |
| 28 | ... | ... | .. | .. | 102 | 72 | 79 | 72 |

### Shape of ends of median strips

Median strips at openings generally have semicircular ends and this shape was assumed in the preceding discussions of median strips. Semi-circular ends are practical of construction, are pleasing in appearance and are fairly satisfactory. They do not, however, fit the natural paths of turning vehicles as well as elongated shapes as is evident in Fig. 8. The difference between a semicircular end and an elongated end increases with the width of median strip and becomes particularly marked when provision is made for trucks turning left or U-turning. In a semicircular end the point of tangency should clear the path of the inner rear wheel of a vehicle turning onto or from the inner lane of the divided highway. A relatively long opening is required. An elongated end results in a shorter length of opening with greater clearance at critical points.

Unnecessarily long openings are undesirable because they encourage promiscuous driving, require unnecessary and unused pavement, discourage pedestrians crossing the divided highway from using the median strip as a refuge, and frequently defeat the purpose for which the opening is made. The paths of vehicles assumed in Figs. 2 and 4, for example, are wide of the semicircular ends of the median strip. Drivers, however, do not naturally swing wide when turning but hug the inside edge of pavement or head for the center of opening. If this is done by a left-turning vehicle and it is required to stop in the median area it will find itself blocking opposing traffic on the crossroad instead of practically clearing it as assumed. If the vehicle is U-turning it will find itself unable to return to the inside lane and be forced to the outside lane. Elongated ends of median strips, on the other hand, follow the natural paths of vehicles and fit in with the idea of channelizing traffic to reduce congestion and conflict.

Any opening in a median strip longer than necessary to accommodate the desired movement should be avoided. Elongating the ends of median strips, as described, will reduce somewhat the lengths of opening in narrow median strips but many of the openings would still be exceedingly long.

The special committee on administrative design policies is composed of the administrative heads or designated assistants of twelve of the leading state highway departments. The purpose of this committee in a major way is the formulation of administrative policies looking toward the incorporation in practice of design features that will give the maximum degree of safety and utility for highway travel. Personnel assigned by the U. S. Public Roads Administration make thorough research into each subject and the material thus prepared forms the basis for consideration and action by the committee with respect to policy.

## Special Cars Built for Heavy Loads

TWO NEW TYPES of heavy duty freight cars of unusual strength and carrying capacity have been developed by the Pennsylvania R.R. for use in the transportation of massive machinery and very large steel shapes and plates. The first cars of these types recently were turned out of the railroad shops.

One of the new cars is a "well-hole" design with the bottom depressed between the trucks. This car has an overall length of 52 ft. 8 in. and a width of 10 ft. 5 in. The central well, 25 ft. 2 in. long, and 7 ft. 8 in. wide, has a depth of 2 ft. 4¾ in. so that the floor is only 20 in. above the top of the rail.

Cars of this type are fabricated of copper bearing steel and are of welded construction. The well is floored with heavy timbers. A standard set of brakes on these cars is supplemented by high power hand brakes.

The other new type is a heavy duty flat car, 45 ft. long and 9 ft. 2½ in. wide, with a maximum carrying capacity of 397,600 lb. The massive steel body of this car is cast in a single unit, while the steel floor plates are riveted to the body. The load is carried on sixteen wheels, and braking equipment is the same as on the well-hole car.

# Public Works Parley in Pittsburgh

***Contents in Brief**—Long-range programming of public works held the spotlight at the American Public Works Association conference in Pittsburgh. Other discussions dealt with subdivision control, traffic channelization, public relations, refuse disposal and sewerage practice.*

PUBLIC WORKS PLANNING and programming, a subject frequently shrouded in academic theory, was demonstrated as a practical procedure for effective municipal administration at the annual conference of the American Public Works Association held at Pittsburgh, Oct. 9-11. Results of a study at Kalamazoo, Mich., were presented, showing the method by which an advance program of public works improvements based on priority of needs could be developed in conformity with financial resources.

Discussions on planning and programming, highlighted by the Kalamazoo report and by the address of John M. Carmody, administrator of the Federal Works Agency, occupied major attention of the 300 delegates to the conference. Mr. Carmody pointed out that past experience has taught the importance of planning as a means of economic preparedness, but that a great deal of skepticism must yet be overcome in regard to the desirability of programming public works over a period of years.

The remainder of the technical program laid emphasis on municipal engineering and administrative problems and practices. It included papers and panel discussions on subdivision control, traffic channelization and safety island design, ways of improving public relations, and refuse disposal.

The following extracts from papers and discussions summarize the technical program of the conference. The officers elected and other news were given in *ENR*, Oct. 19, 1939, p. 505.

## PUBLIC WORKS PROGRAMMING

A study was undertaken in Kalamazoo to determine the practicability of advance programming and budgeting of public works improvements. Fundamentally, this involved the preparation of an inventory of desired improvement projects, a study of the background of past revenue and expenses to aid in the determination of future available funds, and finally, the scheduling of desired projects in an order of priority for the next six years. This long-range program is to be revised annually in the light of changes as they develop.

Selection of the financial and engineering data proceeded simultaneously. Each department of the city reviewed its capital improvements and made an inventory of what was termed "wants". A review of revenues and disbursements from 1920 to 1938 was prepared in such form that a six-year projection could be made on the assumption that no change would be made in the tax levy.

After the priority of projects was determined, a schedule was drawn up definitely allocating projects to each of the next six years in amounts to match the expected available funds. This schedule was arranged so that the first year's program represented a capital budget which could be rigidly adhered to; the program for the later years was set up on a tentative basis to be changed as additional information became available which might call for a revision. The six-year schedule was recognized as tentative, for not only are the estimates of revenue and operating expenses for future years subject to many variables, but new needs will arise to lay claim to certain preferences.

Properly administered, the long-range program will assure that projects are well conceived and properly financed. With some idea as to when projects may be constructed, working plans can be prepared sufficiently in advance so as to minimize mistakes in detail affecting the adequacy and efficiency of projects.—EDWARD S. CLARK, *city manager, Kalamazoo, Mich.*

*Discussion:* A flexible long-range program which can be revised annually is a logical method of providing for public improvements. As the years go by, the background of past experience becomes a valuable aid in formulating orderly procedure. Decisions can thus be made with less confusion.—WILLIAM S. PARKER, *president, Construction League of the United States, Boston, Mass.*

City planning and long range programming go hand in hand. Once the objectives of the city have been established, the development of a program and priority of public improvements will make the plan effective.—LAWRENCE V. SHERIDAN, *regional councilor, National Resources Planning Board, Cincinnati, Ohio.*

To arrive at a compromise between haphazard systems and the rigid long-time plan, the present six-year scheme of the federal government has been worked out. This introduces flexibility and provides for annual review of both financial and physical plans. Seven demonstration studies are under way, of which the Kalamazoo study is one, to determine the mechanics of municipal long-range programming and budgeting. Aside from the apparent value of such programming as an aid toward planning efficiency, it has the further advantage of curtailing the activities of pressure groups whose aims are frequently selfish and not in accord with the best interests of a municipality.—MELVIN SCHEIDT, *technician, Public Works Committee, National Resources Planning Board, Washington, D. C.*

## PLANNING AND PROGRAMMING

In our desire and rush to meet needs, we have unfortunately not always built intelligently. There was no direction to our efforts. We permitted too much to depend upon

chance, and personal and political considerations often determined the types of public works we undertook. Recently this attitude has undergone a healthy metamorphosis. This new outlook has sprung primarily from two sources: first, our extensive experience with public works during the past few years; and second, the ever-increasing accumulation of evidence that advance planning and programming of works can be practical.

The advantages to be gained from approaching public improvements in an orderly way are apparent. A program that is the result of consideration and judgment is obviously likely to insure maximum benefits from the money spent. With a construction program scheduled for years in advance, it is possible for municipalities more or less to stabilize the personnel and operations of its various design and construction bureaus. Funds to finance and operate capital improvements can be organized more logically. Where the necessary authorization for projects depends upon popular referendum, advance planning permits the public to be informed and approval of the citizenry secured well ahead of time. It also offers the possibility of anticipating land requirements, making possible purchase at lower site.

Advance planning and programming of public works holds more than academic interest for those of us entrusted with the administration of the Federal Works Agency.—JOHN M. CARMODY, *Administrator, Federal Works Agency, Washington, D. C.*

*Discussion:* Fifteen years ago we were moving at such a fast pace in public works construction that there seemed to be little time for planning. The situation is different today, and the federal government is thinking seriously in terms of six-year planning programs. But to implement this thinking and make it positive so far as results are concerned, two things must be done: first, the Congress must appropriate money for preliminary engineering studies (which it has been reluctant to do); and second, federal department heads must be urged to think ahead.

Planners have generally been 50 per cent wrong in their ideas, and administrators, too, are about 50 per cent wrong in their thinking. Long-range programming and budgeting procedure is the mechanism by which they may get together for effective cooperation. — HENRY M. WAITE, *chairman, Public Works Committee, National Resources Planning Board, Washington, D. C.*

### SUBDIVISION CONTROL

Cincinnati has materially improved the quality of its physical growth during the last fourteen years through the cooperation of the city council, planning commission and the engineering offices under the city manager. All new streets opened and approved must be in accordance with approved preliminary plats. At first, approval of plats was withheld until sewer and water main sizes and locations had been agreed upon between the municipal engineering department and the subdivider's engineer. Subsequently, to expedite the commencement of subdivision street work the rule was revised to permit tentative approval of the preliminary plat by the plat commission. This is considered as merely a general approval of the layout submitted, and it is thoroughly understood that the city manager shall examine and report as to the grades of streets, the type of improvement, the layout and the drainage of sewer systems, the water distributing system, and shall have the power to modify any such engineering or construction details submitted by the subdivider wherever advisable for the protection of the city's interests.—MYRON D. DOWNS, *engineer, City Planning Commission, Cincinnati, Ohio.*

### SANITARY FILL AT FRESNO

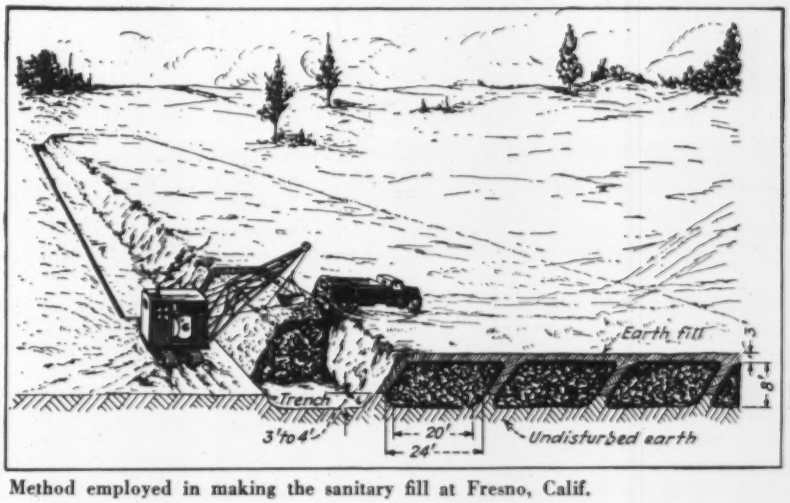
Experience with the sanitary fill method of disposal at Fresno, Calif. where some 24,000 tons of mixed garbage is handled, showed that this work can be done efficiently at a cost of 24 cents per ton. This figure includes all operating costs, as well as depreciation of equipment and a complete write-off of the purchase price of the land, which was $125 an acre. Garbage is dumped in a shallow trench and carried up to a finished height of about 8 ft. The width of the trench is 20 ft. Earth cover material is obtained by digging a trench parallel to the face of the fill. From time to time a motor patrol grader levels off the top of the fill. (*ENR*, Apr. 25, 1935, p. 592.) About 4½ acres are filled each year.

Good practice requires that:

1. Garbage must be covered as soon as possible and within 24 hours.
2. Not less than 18 in. of earth should be used for cover and the earth cover should be placed on the side slopes as well as on top.
3. No burning of any material should be permitted on the fill site.

No rats have been seen at the Fresno disposal site. State sanitary inspectors say that an earth covering of sufficient quantity and depth is the best method possible to protect against rodents. Experience has shown that rats will not burrow through much more than 6 in. of earth and practically never through as much as 12 in.

Temperature tests show that the temperature within the fill rapidly increases after sealing, to a point 20 deg. above the temperature of the surrounding soil. This peak is reached in about ten days, and after 30 days the temperature curve drops and rapidly flattens out so that after nine or ten months the temperature of the fill is the same as that of the surrounding soil. This would tend to




**Method employed in making the sanitary fill at Fresno, Calif.**

show that complete decomposition of garbage has been accomplished in that period of time. This is further borne out by studies which show that all settlement has occurred during the ten months period.—JEAN L. VINCENZ, *commissioner of public works, Fresno, Calif.*

*Discussion*: I do not think that mixed refuse in a sanitary fill will be totally destroyed in five or even ten years, and in consequence the surface of the fill will not reach its final compaction for many years. By theoretical deductions based on incinerator ash production, a 10-ft. refuse fill would shrink to a depth of 1 ft. if destruction were complete. The fact that test holes dug five years after the Fresno fill was placed disclosed unrusted tin cans, and papers whose print was still quite legible, is of course, evidence that decomposition was only partial.—D.W.GODAT, *maintenance engineer, New Orleans, La*

### PITTSBURGH'S PUBLIC WORKS

Pittsburgh is now engaged in the greatest program of public works ever undertaken in this district.

In cooperation with the Public Works Administration the city has direct responsibility for a $12,700,000 program of improvements.

It is interesting to note that more than 50 per cent of the city's share of the cost of these improvements goes right back to the citizens in the form of wages paid by contractors. On three typical projects—a street job, a bridge job and a water main reinforcement—the city's share of the cost was about $140,000. Manual labor received $77,451 in wages.

The city has sponsored a large WPA program, and the quality and efficiency of WPA work has steadily improved. Generally speaking, we have found that WPA has been as good as its supervision and that where time is not of the essence, it is often more satisfactory than contract work because plans can be changed as the improvement progresses without piling up contractor's extras.—FRANK M. ROESSING, *director of public works, Pittsburgh, Pa.*

### TRAFFIC CHANNELIZATION

Channelization is the engineering procedure for improvement of street traffic conditions at intersections or other locations where such improvements are on the basis of allocating the roadway space by means of clearly defining the lanes of traffic. These divisions of traffic are accomplished by the installation of raised islands, signs and pavement markings.

The height of the island above the roadway surface can, for practical purposes, be standardized at 5 in. No individual island of less than 5-ft. width should be considered especially if it is to afford pedestrian protection such as in the case of loading islands. In determining the length of islands, the relative value of foreshortened longitudinal roadway objects to the driver's vision should be given careful consideration. For the purpose of discussion, it can be stated that 10 ft. of actual longitudinal island length observed from a driver's point of vision 30 ft. from the beginning of the island has a value of one lateral foot observed from the same distance. This leads to the conclusion that individual islands should have a minimum longitudinal length of 40 ft. with lengths up to 80 ft. being preferable—CARL V. BERGSTROM, *director, Countywide Traffic Survey, Milwaukee, Wis.*

### PITTSBURGH'S NEW INCINERATOR

Pittsburgh engaged professional engineers to draw up complete designs and specifications for a 600-ton incinerator plant. This procedure placed in the hands of the city the power to obtain maximum quality standards and to prevent compromises that too often result from delegating designs to contractors.

The section of the building containing the tipping pit and charging floor is separated from the rest of the building and has no opening for the outlet of air, thus forming a huge duct for the passage of air to the furnaces and for entrainment of dust and odor. In the furnace, odor is destroyed and dust is settled. Microphone communication between stoking and charging floors aids in closer control of material admitted to furnaces. The stacks are 175 ft. above grate level to provide reserve draft. A scraper conveyor system has been provided instead of the conventional ash tunnel.—D. C. AGAR, *construction engineer, Department of Public Works, Pittsburgh, Pa.*

### IMPROVING PUBLIC RELATIONS

Public relations and all that the term implies does not lend itself to simple definition. Its objectives, however, are not intangible. First, it should strive to eradicate the "public be damned" philosophy frequently adopted by irresponsible civil servants; second, it should be an endeavor to develop citizen interest in the public business of the community.

At Corning, N. Y., all complaints and trouble reports are directed to the public works department, where a clerk records information pertaining to the matter on a printed form. This form contains a space provided for a time clock stamp to indicate the hour of receipt, and calls for the signatures of those to whom it was referred for action; this eliminates "passing the buck". At Rochester, N. Y., a director of public relations was recently appointed to serve as the liaison officer between the city and its citizens; his office is the central clearing house for all complaints.

At Cranston, R. I., cards are sent to every householder on streets where construction work is to be undertaken, stating what is to be done and asking forbearance for any inconvenience that may be caused. At New Haven, Conn., where a river bridge is closed for repairs and the nearest crossing is a half-mile away, the city has placed in operation a free bus service with terminals on each end of the closed bridge in order to minimize inconvenience.

Among those efforts which might be classified as falling in the category of "selling" public works to the public are the tabloid newspaper published bi-monthly by the city of Memphis, the yearly municipal "open house" or exposition which has won considerable interest in Berkeley, Calif., Toledo, Ohio, and Rochester, N. Y., and the encouragement of citizens to visit municipally-owned utilities.—E. J. CLEARY, *associate editor, Engineering News-Record, New York, N. Y.*

*Discussion:* As one means of improving public relations at Cleveland, a Saturday night radio program called "Our Town" has been found effective. The program is fashioned after a New England town meeting in which the mayor acts as a moderator. The programs are devoted to explaining the functions of the various departments of the city government after which there is a ten-minute question-and-answer period in which the public is invited to participate either by attendance at the studio or by means of the telephone.—MILES T. EVANS, *director of public service, Cleveland, Ohio.*

# Driven Cylinder Foundations Built Rapidly

***Contents in Brief**—to support the main piers of three Cleveland lift bridges across the Cuyahoga River, 30-in. steel cylinders are being driven 150 ft. through soft ground to rock, are socketed into the rock and filled with concrete. For loads greater than 625 tons, a steel H-beam is concreted in. Each pier foundation comprises six cylinders supplemented by steel batter piles and a steel sheetpile enclosure.*

SIMPLE AND RAPID WORK marked the construction of the foundations for three new lift bridges that are being built across the Cuyahoga River in Cleveland as part of the river-straightening now in progress. The pier locations are in soft ground that extends to a depth of 150 ft. below river level, yet a complete pier foundation was built in four weeks. This speed is due to the use of steel cylinder foundation units.

The units, which are steel tubes driven to rock and after excavation filled with concrete, are analogous to piles, but because of their large diameter (30 in.), the socketing into rock, the fact that they can be entered and inspected during construction (including inspection of the seat on or in the rock), and the high load capacity obtained (up to 1,185 tons per unit), they are in fact cylinder foundations. How well their size adapts them to internal inspection is illustrated by Fig. 1, showing an engineer about to be lowered to the bottom of one of them.

The Cuyahoga Valley through Cleveland is deeply filled with soft sediments, consisting of beds of sands, gravels and clays. Foundations for a movable bridge, especially for the high towers of a lift bridge, must be stable and rigid against both settlement and lateral displacement, and it seemed difficult or impossible to assure this condition by any form of foundation supported in the soft strata themselves. The consulting engineers whom the city of Cleveland retained for the work, George B. Sowers, Wendell P. Brown, and the late Wilbur J. Watson, therefore decided to carry the bridge pier foundations to rock. The driven-cylinder type of foundation made it possible to do so cheaply and rapidly.

The three bridges are the Columbus Road bridge, about one mile upstream from the mouth of the river, replacing a double swing bridge built

Fig. 1. **Going down into a 30-in. foundation cylinder to inspect rock bottom.**

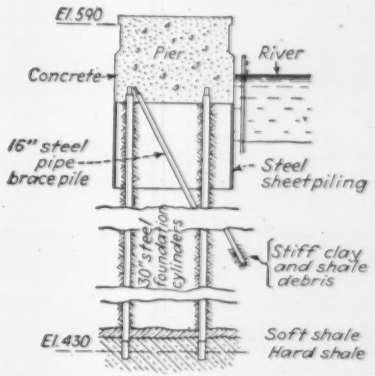



Fig. 2. **Carter lift-bridge pier supported by cylinders about 140 ft. long and braced by steel batter piles.**

in 1894; the Carter bridge, on new location about ½ mi. above Columbus Road and intended to take the place of the old Collision Bend swing bridge, whose foundations were built about 1873, a third of a mile farther upstream; and the West Third St. bridge, three miles above the river mouth, replacing an existing swing bridge built in 1883. The two latter bridges will provide a 200-ft. channel between fenders, the Columbus Road bridge a 220-ft. channel, all three with clearance height of 97.3 ft. when open; tower tops will be about 165 ft. above water. The roadways will have four vehicle lanes and 5-ft. sidewalks; light decks are being provided on the lift spans, two of them open-grid flooring. The West Third St. bridge will have a floor of concrete-filled grid.

The river in the vicinity of the bridges flows through a channel cut in an alluvial delta formed during the glacial period, according to geologists. Bedrock, 140 to 160 ft. below river level, is hard Chagrin shale (Devonian) free of soft or clay seams but slaking on exposure to air. It is overlaid by 10 to 40 ft. of clay, gravel and shale debris with pockets of sand and gravel, 20 to 50 ft. of gravel, sand and soft clay, 20 to 40 ft. of very soft plastic clay, and a surface layer of clean sand and gravel about 25 ft. thick.

Water was found in all the sand

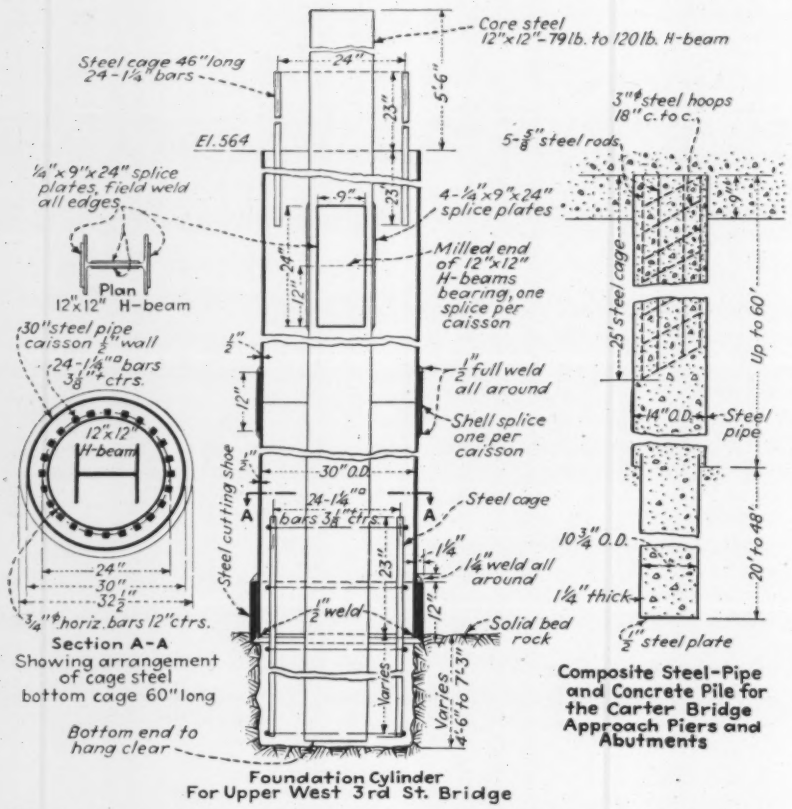



**Fig. 3.** Details of the 30-in. foundation cylinders and (right) one of the composite piles used in the approach structures.

layers. One pier showed salt water under artesian head at 80-ft. depth. Scattered small boulders, sometimes in pockets, were encountered at all levels. Natural gas was present in large volume and at high pressure in a thick sand and gravel layer about 80 ft. below water. In some prior deep foundations in Cleveland gas caused much trouble and killed several men.

### Foundation types

Either concrete caissons of large diameter or small steel concrete-filled shafts or cylinders were considered suitable foundation types for the lift-span piers. The composite steel and concrete shafts proved to be cheapest, and were adopted.

These composite cylinders consist of spiral-welded steel pipe 30 in. in outside diameter and with shell thickness of ½ to ⅝ in. They are driven vertically, cleaned out, seated in sound, solid rock, and extended 4½ to 9 ft. farther into solid rock by sockets of the size of the inside of the pipe churn-drilled from the surface; finally they are filled with 5,000-lb. concrete after a bar reinforcement cage is placed in the rock socket and for a height of 3 to 5 ft. up into the pipe to replace in steel area the cross-section of the pipe.

For the heaviest loading (loads exceeding 1,250,000 lb. per cylinder), a steel H-beam is set in the cylinder before concreting, being centered at the top and hung free to assure its verticality. With this steel core, a load capacity as high as 2,370,000 lb. per cylinder is obtained.

The cylinder shafts are designed to take the full vertical load as axial composite columns supported laterally by the surrounding plastic earth.

### Driving the cylinders

Each cylinder shell comes to the job in two sections, the lower fitted with a tool-steel shoe with tempered cutting edge and the abutting ends fitted with collars to hold the two sections in alignment when welded. The sections are driven with a No. 0 Vulcan steam pile hammer to firm bearing of the shoe in sound shale. Usually the first 70 ft. can be driven without cleaning out, but in the harder clay and sand strata several drives are made after excavating the soil from inside the pipe. Driving the spiral-welded pipe, including the field-welded splice, to virtual refusal has not cracked or opened a seam or joint, Mr. Sowers reports.

During the driving, any hard layers encountered are broken up with a churn bit after cleaning out the pipe; driving and cleaning out the pipe proceed until the cutting edge is seated in sound rock. The soil is removed from inside the cylinder by driving a coring tool consisting of a 22-in. pipe fitted with end attachments having varying-sized openings into the core soil, lifting it out and ejecting the contained plug with steam. For hard clay the attachment is a simple cutting-edge ring, for soft clay a ring with cross-bars or a valve.

When the foundation cylinder is

**Fig. 4.** A hole or socket is churn-drilled into the shale below the cutting edge of the cylinder to distribute the load and tie the pier to the rock.

cleaned out down to the bottom, a 30-in. hole is churn-drilled into the rock to a depth sufficient to transfer the full load by lateral bond at a stress of 150 lb. per sq. in. (see test in connection with building of foundations for the New York City municipal garage, *ENR*, Sept. 9, 1937). For the maximum load this means a depth of about 9 ft. Finally, as the last step before concreting, the inside of the cylinder is washed down, the socket is cleaned out, and the whole interior inspected by an engineer who is lowered to the bottom in a bar cage. The thoroughness with which this inspection may be carried out can be judged from Fig. 4, a photograph taken from the inspection cage at and just below the cutting edge. It shows the side of the rock socket just below the cylinder shoe.

The cylinders so far constructed are reported to be perfectly straight, exactly on the required locations, and not more than one or two inches out of plumb in their full height. In sinking 12 cylinders for the Carter Bridge an average time of 3½ days was required for sinking and filling one cylinder.

### Brace piles and sheeting

To hold the pier against earth thrust toward the river, six batter piles 16 in. in diameter with ⅜-in. shell of high-carbon steel are driven on a 1:2 batter by means of a No. 50-C Vulcan steam pile hammer to a calculated safe loading of 80 to 100 tons. These brace piles foot in the top of a hard clay layer about 80 ft. below river level.

Around the entire pier superstructure a wall of steel sheetpiles is driven to 40 ft. below river level, to tie together the mass of soil directly below the pier concrete and to retain the earth along the side of the river channel, which is to be dredged 12 or 14 ft. below pier base after completion of the substructure work.

The pier superstructure itself is a prism of 5,000-lb. concrete mixed with a plasticizer to assure maximum density and resistance to disintegration. After removal of forms the pier sides are coated with metallic waterproofing (pulverized iron and oxidizing chemical) which soon oxidizes to a deep brown color; the oxidizing iron is applied to waterproof the concrete and give it a rich brown coating that will resist weathering and not show subsequent discolorations.

The bridges under discussion are part of a project for improving the sharply winding channel of the Cuyahoga by cutting back the bends and widening the channel at an ultimate cost of $20,000,000 and a present expenditure of $6,000,000, contributed by the PWA, the Corps of Engineers, and the city of Cleveland. Ultimately 5½ miles of the river and inner harbor will accommodate the largest lake freighters, 630 ft. long by 65 ft. beam. George B. Sowers is consulting engineer in charge of the entire project.

The Upper West Third St. bridge was designed by Wendell P. Brown, consulting bridge engineer. The Carter bridge and the Columbus Road bridge were designed by the late Wilbur J. Watson, whose work is being completed by Ralph Harding of Wilbur J. Watson and Associates. The foundations of the six piers are being built by the Western Foundation Co., of Chicago, which holds patents covering the type of cylinder foundations used and the method of excavating soil from the cylinders.

# Sanitary Survey of River At Grand Rapids, Mich.

A SURVEY of the Sanitary condition of the Grand River, in relation to the effluent from the sewage treatment plant of Grand Rapids, Mich., was a feature of the work of the city's department of public service during the year ending with March, 1938. On a stretch of 18 mi. samples were taken at five stations, the first a mile above and the fifth 17 mi. below the plant outlet. This survey supplemented five others since 1930, but was more complete than the earlier ones.

It was arranged to take samples over a 24-hr. cycle for as many days as possible with a limited personnel. Stress was placed upon the value of the 24-hr. period, as the average variation in dissolved oxygen is 1.5 ppm from maximum to minimum and is sometimes as high as 3 or 4 ppm. A total of 2,364 samples was collected at the five stations. Sampling periods were at approximately 8-day intervals, and six samples (4-hr. intervals) were taken at each station. Weekly samples well represented the average condition of the river, and conditions for an average day were obtained from samples taken at 4-hr. intervals through a 24-hr. period.

In addition to the water sampling, there were velocity measurements and cross-sections taken at each station. The sampling period, June 1 to October 31, was arranged to coincide with the low river flow in summer, in order to observe the worst conditions of pollution. The river flow averaged 1,970 cfs for the period. Each sample was tested for dissolved oxygen content, temperature, biochemical oxygen demand chlorides, total bacteria and B.coli index. A summary of results is given in the accompanying table.

SANITARY SURVEY OF GRAVEL RIVER AT GRAND RAPIDS, MICH.

| Station | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Mi. from plant outlet | 1 (up) | 1.3 | 4.4 | 14.0 | 17.3 |
| Mi. between stations | ..... | 2.3 | 3.1 | 9.6 | 3.3 |
| Dissolved oxygen, aver., ppm | 8.1 | 7.7 | 6.4 | 5.5 | 6.1 |
| Dissolved oxygen, max ppm | 7.0 | 10.9 | ..... | 9.5 | 9.3 |
| Dissolved oxygen, min., ppm | ..... | 5.4 | 3.4 | 1.6 | 3.2 |
| Biochemical oxygen demand, aver., ppm | 3.3 | 4.3 | 3.9 | 2.7 | 2.6 |
| Bacteria, total per cc | 2,460 | 117,700 | 206,500 | 108,390 | 71,940 |
| Bacteria, B.coli Index per 100 cc | 2,360 | 113,300 | 235,300 | 60,560 | 61,000 |

The disposal plant serving Grand Rapids and East Grand Rapids (population 174,500 and 4,100) is of the primary treatment type, with separate digestion; sludge is dried on open beds. Its designed capacity is 32.5 mgd. A new fertilizer sludge-cake storage building and a grinder and drying plant were put in operation in March, 1938. Cost of operation in 1937-38 was $56,237; $546 per mg treated, $154 per day at 31.5c. per capita per year. This last cost reached a maximum of 40.5c. in 1931-32 (the first year) and a minimum of 23.9c. in 1933-34.

# BOOK NOTES AND REVIEWS

*The month's additions to the engineer's reading and reference list*

## Geology for Engineers

GEOLOGY AND ENGINEERING — By Robert F. Legget. 650 pp. Published by the McGraw-Hill Book Co., New York and London. Price $4.50.

Prof. Legget's volume on "Geology and Engineering" should do much to promote a better understanding of the relationship between these two sciences. The book is largely "qualitative" rather than "quantitative". Technical terms and expressions are used sparingly and engineering formulae are generally avoided. The result is neither a treatise on geology nor a text book on engineering, but an interesting and helpful discussion of interrelated features of both.

The volume consists of three parts. Part I contains a brief outline of the principles of geology. The author suggests that it be skipped by readers familiar with these principles. Many civil engineers will profit from its reading. Part III contains useful glossaries, indices, and general reference data. Part II contains the primary substance of the book.

Some readers may think the beginning of Part II elementary; many will find it profitable reading. Beginning with Chapter VIII, interest is continuously sustained by informal discussions of the geological problems encountered in a wide variety of engineering undertakings. These discussions are interesting and practical but generally non-technical. The chapter on tunnels, for example, makes no attempt to instruct the reader in the details of design and location, but endeavors to explain in simple language the possible influence of geological features on construction costs and procedures. Many illustrative historical examples are cited. In other chapters, conditions tending to cause landslides in open cuts, canals, etc., are recited. Geological and mechanical stability factors are discussed but rules for their determination are lacking. Chapters on foundations, water supply, groundwater, erosion and silting, materials of construction, and other interesting subjects, follow the same plan—by no means to their detriment. The author's purpose is to share with the reader a rich accumulation of experience concerning the influence of geological formations on all classes of civil engineering works.

Exception is likely to be taken to the statement on page 68 that "This book is not intended for the use of geologists and it would be invidious for the author to comment upon the attitude of geologists toward civil engineering work." Many engineers—even many who regularly employ geologists—are skeptical of the practical value of geological work. This skepticism frequently results from failure of the geologist to comprehend what the engineer needs. The engineer needs not only a description of geological features but also an interpretation of them in terms of his requirements. He not only needs to know the composition of a rock, or of the existence of a major or minor fault, he needs help in forming a conclusion as to how these factors, and others, will affect his work. The careful reading of at least the major portion of Part II will help the geologist to an understanding of this situation. Admittedly, much of the book will seem elementary to the trained geologist, but other parts will appear equally elementary to the engineer. It is the merging of the two points of view that imparts value to the work.

The book might have been abridged in some respects without detriment, but any deficiency in this respect is offset by its thoroughly readable style.—*Reviewed by* JULIAN HINDS, *Assistant Chief Engineer, Metropolitan Water District of Southern California.*

## Map Making

GENERAL CARTOGRAPHY—By Erwin Raisz. 370 pp. Published by McGraw-Hill Book Co., New York. Price, $4.00.

Professor Raisz has prepared an all-around handbook for those who would learn cartography—one which covers all angles of the map-making art from its history to means for drafting. The volume is divided into two books, General Cartography and Special Maps. The first book begins with four chapters on the history, then goes into sections on scales and projections; representation of the earth's pattern on maps; and lettering, composition and drafting of maps. The second book covers official and professional maps; diagrams, statistical maps and cartograms; science maps and diagrams; and globes, models, field sketching and cataloging. Two hundred illustrations amply augment the text material. In one noteworthy chapter, engraving and other allied subjects, which are apt to be vaguely understood even by an experienced mapmaker, are explained simply and quite clearly.

## Speaking Effectively

PUBLIC SPEAKING FOR TECHNICAL MEN—By S. Marion Tucker. 397 pp. Published by McGraw-Hill Book Co., New York and London. Price $3.

This book should be prescribed reading for all engineers who wish to present papers before technical societies; it will be found to be worthwhile reading by any engineer who ever hopes to lead such meetings or take part in the discussion.

The book is written expressly for such men. The author opens with a description of a typical engineer's convention that will strike a responsive note in the mind of any reader who has sat on a hard seat trying vainly to follow the droning of the speaker, vainly hoping that the paper will end soon and that the next speaker will be better. Fictitious speakers from a wide range of types are presented and then an informal discussion of their faults is taken as an easy and effective way of pointing out how such faults can be corrected. Also given is valuable information on how papers should be organized for oral presentation and how illustrative material should be handled. Special stress is laid on means for getting and holding the attention of an audience.

The author points out that he has not attempted to write a book of specific instructions on public speaking. There are many such texts. What the author attempts to do is to tell the technical man how to handle himself and his material so that his hearers will get the most out of what he has to say. And largely between the lines

is a continuing dissertation on the importance to engineers of ability to speak effectively.

## Sewage Handbook

TASCHENBUCH DER STADTENTWASSERUNG (8th Auflage)—By K. Imhoff. 252 pp. Published by R. Oldenburg, Munchen und Berlin. Price 6.50 RM.

This revised and enlarged pocket handbook for sanitary engineers contains much practical information on the planning, construction and operation of sewers and treatment plants. The basic principles of sewer design are illustrated in a series of graphs. The section on sewage treatment is brought up-to-date with particular emphasis on settling, trickling filters, activated sludge and sludge digestion. Chemical treatment and sludge dewatering is treated very briefly. The book is written in a positive style for the practicing engineer with avoidance of detail, but sufficiently complete to make it valuable for those who do not have access to extensive current literature. Although obviously intended for German practice this neatly bound well printed book is a valuable asset to those interested in the field who can read German.—*Reviewed by* WILLEM RUDOLFS, *Chief, Division of Water and Sewage, New Jersey Agricultural Experiment Station.*

## Welded Construction

WELDED STEEL CONSTRUCTION—By Robert S. Hale. 170 pp. Published by the Pitman Publishing Corp., New York. Price $3.

Concise information on the advantages of welded steel construction in building work and on current practices in the application of welding to such operations is given in this small book. It is not a textbook on welding methods but rather a guide to the structural engineer or architect who wishes to gain knowledge of how welding can be applied to his structural problems. A considerable part of the book is given over to the application of welding to structural design, pointing out how welding construction varies from riveted work. Also included is valuable information on estimating structural steel costs, a brief description of methods of fabrication and erection and a section on the inspection of welded work. An appendix includes tables of standard sections, the portions of the New York and Chicago Building codes that relate to welding, and the American Welding Society's specifications for highway and railway bridges by fusion welding.

Though the book itself is small it contains numerous references to fuller works on the various subjects covered.

## Panorama of a Century

THE LIFE AND WORK OF WILLIAM CAWTHORNE UNWIN—By E. G. Walker. 239 pp. Published by the Unwin Memorial Committee, 15A, Grosvenor Mansions, 82, Victoria St., S.W. 1, London. Price 12s. 6d. Obtainable through the American Society of Mechanical Engineers, 33 W. 39th St., New York, N. Y.

MY FIFTY YEARS IN ENGINEERING—By Embury A. Hitchcock in collaboration with Merrill Weed. 277 pp. Published by the Caxton Printers, Ltd., Caldwell, Idaho. Price $3.

A hundred years of intimate engineering history is covered by two books, Walker's story of Unwin's career and Hitchcock's story of his own life. The period covered by the Ohio State dean overlaps that of his English colleague as also does the setting of the two stories, for Unwin was engaged in studying the Niagara Falls project while Hitchcock was a Cornell undergraduate not many miles away. Together the two "lives" afford a remarkable panorama of engineering development from the 1830's to the present.

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Walker's biography of Unwin relates that the noted engineer and teacher was born in an English parsonage in 1838, when railroads were just beginning to spread over the country and colleges were venturing into a few scientific courses, and at 18 found employment as personal assistant to William Fairbairn when the latter was at the height of his career. Only a short time before Unwin began his apprenticeship the Board of Trade had prescribed that cast iron bridges require a factor of 3 for dead load and 6 for live load, and a few years later the limit of stress for wrought iron bridges was set at 5 tons per sq. in. A 16-in. wrought iron plate girder on 20-ft. span was tested by Unwin under impact, vibration and repeated loading about 1860. The date of publication of Unwin's first book, "Wrought Iron Bridges and Roofs", in 1869, is a striking reminder of the short period of time during which today's extensive civil engineering literature developed.

The story of Unwin's connection with Niagara Falls power, of his work on engines, on dams, on a steel conduit for the East Jersey Water Co., and on pressure vessels, amplify the picture of a great career.

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Hitchcock, another minister's son, had an equally varied life. Its details have the zest of personal reminiscence reported in the first person singular, and place many recent events and personalities in the limelight. From early work in a cement plant, in Sweet's Straight-Line Engine Works, and the Corliss shop at Providence, young Hitchcock turned to a teaching career under the noted S. W. Robinson, to stay for a "couple of years' teaching", which actually ran to twenty. He then went back into engineering practice, but was recalled to Ohio State as dean of engineering in 1920.

Dean Hitchcock's pictures of men, companies and affairs are unusually varied and include many incidental philosophic observations. Among the interesting passages is his graphic account of how he tested locomotives during regular runs at high speed, and his study of water-power possibilities in the Tennessee Valley 25 years ago. But many readers will get the biggest kick out of the story of how four professors, including Hitchcock and "Chris" Sherman, went into contracting as a sideline and took a 7-mi. grading contract on the Big Four in Indiana, with disastrous effect on their pocketbooks.

## Building Wall Details

PRINCIPLES OF MODERN BUILDING, VOL. I, Walls, Partitions and Chimneys—By R. Fitzmaurice, 405 pp. Published by His Majesty's Stationery Office, London. Price $2.90 from the British Library of Information, 50 Rockefeller Plaza, New York, N. Y.

There is no lack of books on the major phases of building construction from design to erection, but there has been an almost complete lack of published data on the many minor points that involve no structural design or set formula. In "Principles of Modern Building" the author has given the answer to hun-

dreds of questions not heretofore put in handbook form. The fact that these answers are based on research to answer problems submitted by the construction industry from time to time, gives the book added value. Masonry walls are particularly well covered.

Typical of the general approach is the statement on p. 25: ". . . Recent revision of building regulations has introduced an important change in principle, and the designer of a building is given two alternatives on which to work; he may use the old rules which relate thickness of walls to height and length, or he may design walls on the basis of permissible stresses appropriate for the particular materials to be used . . ." The large number of tables and references then included makes it possible to carry out this method of designing masonry walls. A procedure that heretofore has been difficult due to the lack of information available.

Other subjects covered are surface finish for exterior walls; damp walls; and special structural features.

There is nothing like the book in this country. It might well be labeled a handbook for the builder of unit masonry construction.—*Reviewed by* J. H. HANSEN, *Secretary, Brick Manufacturers Association of New York.*

## More Practice Than Theory

THE THEORY AND PRACTICE OF REINFORCED CONCRETE—By Clarence W. Dunham. 529 pp. Published by McGraw-Hill Book Co., New York and London. Price $4.50.

The conventional title of this book is somewhat misleading, for its contents definitely reflect a practical as opposed to a theoretical approach. One gains the idea that the members and structures considered are not only to be designed and proportioned so that they can be pictured on a blueprint but that it is intended that they actually be constructed. This approach is by no means common in texts devoted to reinforced concrete design, and it adds greatly to the importance of this book for the practicing engineer. Furthermore, this treatment in nowise detracts from its usefulness for the college student. The author draws on his extensive design experience with the Port of New York Authority to make the examples and the practice problems lively and stimulating.

In the first seven chapters covering stresses and reinforcement in beams, slabs and columns, elementary design considerations are disposed of. Thereafter attention is directed to design procedures for retaining walls, foundations, rigid frames, arches, building framework and miscellaneous structures. Architectural considerations and requirements and a chapter on such practical details as expansion and construction joists, waterproofing, reinforcement at openings and the like complete this book, which deserves high rank in its field.

## *MISCELLANEOUS NOTES ON BOOKLETS AND REPRINTS*

REVISED EDITIONS of Simplified Practice Recommendations R163, Coarse Aggregates (crushed stone, gravel, and slag) are now available from the Superintendent of Documents, Washington, D. C., price 5c. The documents are prepared by the National Bureau of Standards.

THE ABC'S OF SOIL STABILIZATION, a group of articles published in "The Earth Mover and Road Builder", has been published in reprint form by the Burton Publishing Co., 407 So. Dearborn St., Chicago. Price 25c. The articles deal with soil stabilization for road construction.

CURRENT PROGRAMS OF WORK of the state planning boards is the subject of Circular XI, National Resources Planning Board, North Interior Building, Washington, D. C. Circular XII of the same board covers state legislation on planning, zoning and platting.

MATHEMATICAL TABLES to supplement those normally found in handbooks of engineering, physics and related sciences are being computed by the Works Project Administration in New York City (70 Columbus Ave.) under the sponsorship of the National Bureau of Standards. Information as to the tables can be obtained from the New York office.

SIDE-HILL GOUGERS, wampus cats and other animals that have followed survey parties through backwood regions from time immemorial have now come out into the light in a booklet entitled "Fearsome Critters" written by Henry H. Tryon, forest engineer. Each animal is pictured and briefly described. Price, $2 from the Idlewild Press, Cornwall, N. Y.

FLOODS AND HURRICANES in Massachusetts are the subject of a report published by the Massachusetts Department of Public Works, 100 Nashua St., Boston. The first section is entitled "High Water Data—Floods of March 1936 and September 1938 in Massachusetts", and the second section is entitled "Storm Tide Hurricane of September 1938 in Massachusetts." The report sells for 40c.

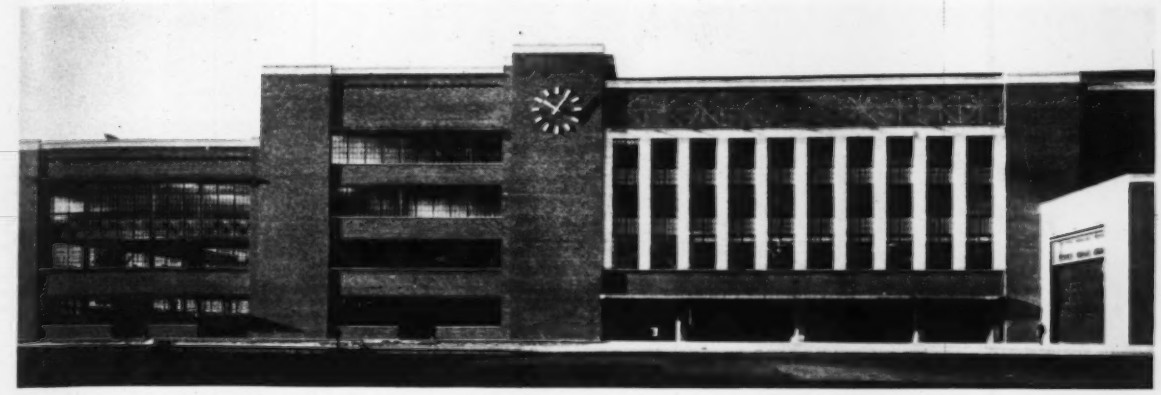
HIGHWAY JOBS is the subject of Occupational Monograph No. 8 published by Science Research Associates, 600 So. Michigan Ave., Chicago. Price 50c. The pamphlet tells what are the duties required of the several grades of men in our state highway departments and the average compensation for each grade.

ACCIDENT RATES IN THE CONSTRUCTION INDUSTRY is the subject of a pamphlet published by the National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill. The pamphlet covers the year 1938 and indicates a continued decline in both frequency and severity of accidents, but shows the construction industry having about double the frequency and severity rates of all industry.

ENGINEERING SOCIETIES OF NEW ENGLAND, INC., has published a 118-page Directory of New England Research and Engineering Facilities, with index of consultants, services and laboratories available, dates of organization and qualifications of many specialists, and notation of types of work covered by various groups, firms and individuals listed. Price of directory $2. Societies' address, 88 Tremont Street. Boston, Mass. New England Council co-operated in the compilation.

CURRENT SUBJECTS covered by the "Building Materials and Structures Report" of the National Bureau of Standards are BNS20, Structural Properties of "Twachtman" Construction for Walls and Floors; BNS22, Structural Properties of "Dun-Ti-Stone" Wall Construction; BNS23, Structural Properties of a Brick Cavity-Wall Construction; BNS28, Backflow Prevention in Over-Rim Water Supplies. These reports can be obtained from the Superintendent of Documents, Washington, D. C., price, 10 cents each.

*For the listing of new books and pamphlets, see p. 96 of this issue.*



# PORTFOLIO *of* 1939 BUILDINGS

**ENGINEERING NEWS-RECORD** **October 26, 1939**

TEN notable buildings of the year are described in the following thirty-two pages. Lacking clairvoyance and all-embracing wisdom, the editors make no claims that each of these buildings is the best in its particular class, although on almost any basis of comparison they would rate outstanding merit. The least that can be said of them is that they are typical of modern architecture and engineering, and the reader can hardly fail to sense that they represent the result of more than ordinary effort to effect a combination of the fruits of technical science and of modern equipment and materials research.

Nearly every major type of building is represented, including housing, schools, office buildings, industrial plants, factories, public buildings and power stations. The engineers and architects who created them marshalled a wide variety of materials—steel, concrete, brick, glass, gypsum, asphalt, porcelain enamel, rockwool, cork, fiber board, asbestos, copper, wrought iron, marble, clay tile, timber, brass, aluminum, natural and artificial stone, cast iron, tar, paint and even paper. By taking advantage of modern knowledge they provided efficient unobstructed working and living spaces, clean, fresh air, acoustical control, high-standard lighting, and economical maintenance. In short, faced with the age-old problem of providing a building for a particular use at a cost that the owner could afford, the engineers and architects found among the new things that are available a large number that made the solution easier and better.

At the same time it will be evident from reading the articles that modern building design requires a much broader knowledge on the part of the architect and engineer than did older, more simple structures. Mechanical facilities, for example, have not only become more intricate and varied, requiring acquaintance with their advantages and disadvantages for intelligent selection, but in the matter of air conditioning they have exerted effects on the walls, frame and space layout that must be evaluated. New materials have special strength, expansion, weathering or wearing properties, and with these the designer must become familiar. New products for roofs, walls and interior finish claim advantage in cost, maintenance or installation about which he must have an intelligent opinion. And even though this wider knowledge may only be used to reject new products or processes in favor of older ones, it is vitally necessary, for only by familiarity with all that is available can an engineer or architect serve his client efficiently.

Each of the buildings described in this 1939 portfolio involves something new or unusual, which it is hoped may be suggestive and stimulating to the designers of the buildings of 1940.

## In This Section


| | |
|---|---|
| Office Building, Des Moines | 63 |
| Tire Factory at Natchez | 67 |
| Apartment Housing, New York | 70 |
| Coffee Roasting Plant, Hoboken | 73 |
| Power Plant, Holland, Mich. | 75 |
| Automobile Press Shop, Detroit | 78 |
| High School, Girardville, Pa. | 82 |
| Baking Soda Plant, Syracuse | 84 |
| Municipal Building, Topeka | 88 |
| Drafting Offices, Chicago | 92 |

*BUILDING comes back, as this view of granite setting on the Bankers Life Building in Des Moines suggests. And it is characterized by new designs, new products and improved techniques.*

FIG. 1. IMPOSING NEW HOME OF BANKERS LIFE COMPANY, DESIGNED FOR UTILITY AS WELL AS FOR BEAUTY.

# Insurance Office Building at Des Moines

LELAND A. McBROOM

Tinsley, McBroom & Higgins, Architects, Des Moines

***Contents in Brief—Long-span structural framing to create large office areas without columns; limestone, glass, bronze and granite exterior; enameled steel plate interior finish, perforated metal ceilings for air conditioning; and a wall heating system are features of an unusual home office building for Bankers Life Company at Des Moines. Foundations in variable soil consist of a rigid concrete frame on spread footings.***

IN CONTEMPLATION of some day building a new home office, the Bankers Life Company of Des Moines for years had made careful studies of its peculiar needs and requirements. Consequently, when the decision was finally made to go ahead with its new building program, an intelligent and inclusive plan was submitted to the architects, largely based on faults found in the company's present inadequate quarters in the upper floors of a commercial office building. Starting with the well-formed ideas and desires of the owner, and with the company's continued cooperation, the architects designed a building that for years to come would present an environment as nearly perfect as possible for the efficient conduct of the home office business with the lowest possible cost for the upkeep of the structure. If the efficiency of the large force, whose payroll runs about $1,000,000 annually, can be maintained at a high level or even slightly increased, the trouble and expense devoted to proper lighting, color schemes, and control of sound and atmospheric conditions will be a good investment.

As a result of these considerations and careful planning, the building, now under construction, is unusual in its class both in structural and architectural design. Seven stories high, it is faced with Rainbow granite from Cold Springs, Minn., to the third floor, and with Ilco cream vein Bedford limestone from that level to the top. Spandrels, casement windows and exterior doors are of bronze, and the windows are set in large panels of glass brick. The interior finish, in general, is enameled steel sheets. Lighting, heating, air conditioning and insulation have been given special attention. These exterior and interior features, while adding slightly to the initial cost, were adopted in view of lower maintenance costs and improved working conditions.

## Functional layout

The insurance company found that the greatest hindrance to effective arrangement of large clerical departments in its present quarters were the interior columns on the conventional 18-ft. spacing. First requirement, therefore, was the elimination of all columns in the clerical areas. The 600 employees of the home office are grouped into a few large departments that function best on a single level. With this in mind the company acquired a site more than a city block in area for its new building, close to the central business district.

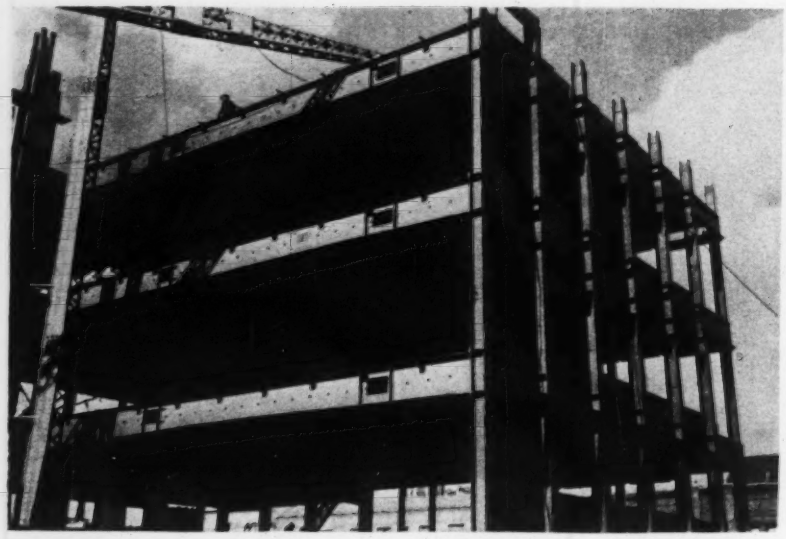
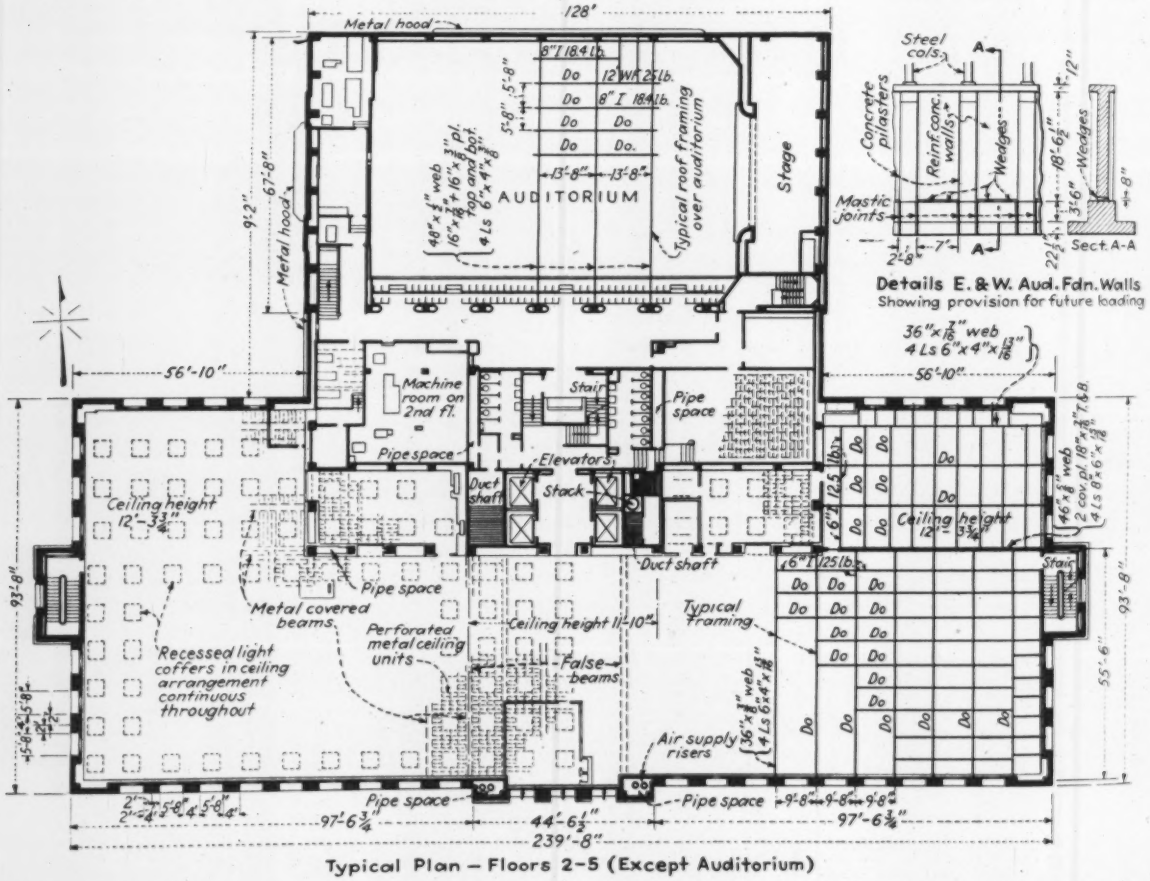


**Fig. 2.** Long spans providing large clerical areas free of columns are features of structural framing. Openings in the webs of 36-in. girders are for air ducts, pipes and conduits. The deep steel spandrels were later faced with bronze.

As finally analyzed, the plan resulted in a main building 94x240 ft., with the basement for service and equipment, ground floor for dead filing and mailing, first floor for entrances and live files, second to fifth floors for clerical areas, sixth floor for executive offices and a partial seventh floor for the director's room and top mechanical plant. Each department was laid out by the department head and criticized by the executives as though it were unhampered by walls. These free functional arrangements were then studied to find the span and window spacing most nearly suited to the needs of all. The final plan for clerical areas was a U-shaped arrangement 230 ft. long and 90 ft. wide, with a minimum clear span of 53 ft., as shown in Fig. 3. This provides for more than 16,000 sq.ft. without columns on each of four floors.

A 91x123-ft. extension to the rear of the main building houses a 1,000-seat auditorium and employee recreational facilities. The auditorium roof meets the main section between the second and third stories. The lower part of the exterior is finished with granite, the upper part with limestone. As the inside of the auditorium section parapet will be visible




Typical Plan — Floors 2-5 (Except Auditorium)

**Fig. 3.** Typical plan of one of the clerical floors. The long-span girders allow areas 53x235 ft. with wings 35x53 ft. unhampered by columns. Future extensions will be built on both sides of the auditorium, maintaining the same wide clear spans. Details of the special foundation arrangement along the auditorium walls for future loading are at the upper right.

from the upper floors, it is finished in greenstone. A future expansion of the main building is planned on both sides of the auditorium, which required designing the foundation and structural frame along the sides to carry the future girders.

### Foundations fit soil conditions

Downtown Des Moines is built on a prehistoric riverbed, so soil conditions are variable. To determine the exact conditions at the site, numerous test holes were bored, some going as deep as 80 ft. below the probable footing level. All footings were placed on a layer of highly compacted sand and gravel 5 to 15 ft. thick. Beneath this formation was found a compressible blue clay of irregular thickness from 4 to 8 ft. A layer of dry granular material underlies the clay, and deep down, at fairly constant level, was found a heavy blue shale.

Naturally for foundations in such ground the first thought was use of piling. However, in a similar situation a few years ago the architects found that cost of piling would have made the building impossible. In place of piles, they developed a foundation of continuous concrete wall tied with crosswalls, all heavily reinforced at bottom of footing and top of wall. Footings and walls were doweled together to act as a unit, and additional reinforcing in the sides of the walls made the entire unit a large girder that distributed the load over variable-bearing soils. This plan worked so well and the savings were so large over piling that a similar scheme was considered for the Bankers Life Building.

Before proceeding, the architects consulted Prof. Arthur Casagrande, of Harvard. As he had just developed a similar foundation for a building in Boston, he readily approved the Des Moines plan. From soil bearing tests, loading of 6,000 lb. per sq.ft. was used for the foundation design.

An unusual foundation arrangement was made along the sides of the auditorium where some day the walls will carry a six-story load of future extensions of the main building. It was desired to build the foundations complete at the present time to carry the future loads, yet in view of unfortunate experiences in similar cases in Des Moines soil it was considered unwise to load the foundations lightly now with only the auditorium wall and roof and then apply the heavier load later. This was avoided by dividing the continuous footing into sections—2 ft. 8 in. long under the columns, and 7 ft. long between the column sections—separated by a mastic joint. The foundation wall was tied in with the column sections of the footing, but a space of 8 in. was left between top of footing and bottom of wall between columns, as shown in Fig. 3, upper right. In each of these spaces were placed two sets of iron wedges, left loose. Under the present light loading, only the column sections of the footing are loaded. In the future, when the foundation load is increased by the extended building, the wedges will be tightened up so the wall will bear on the remaining footing sections, and thus the increased load will be distributed to these footing sections through the rigid foundation wall.

The various openings throughout the foundation walls were reinforced to retain the continuity of the walls as beams. At the corners, where future walls are to connect, continuous action of present and future reinforcing bars was provided for by placing female threaded connections at the ends of present bars. These connections were filled with grease and sealed.

### Structure framing

The wide spans on the clerical floors presented problems in structural design, and after careful study a steel skeleton with flat tile arches was determined as most economical. The structure design was worked out in the architect's office by Ray Keller, structural engineer. Simple beams stiff enough to reduce deflection to the desired minimum were found to be too heavy and costly. However, by designing the beams and girders for continuity in both directions and for frame action between columns and beams, the weight of steel was reduced to economical limits.

Columns and transverse beams are rolled sections, but the long-span girders are built-up riveted sections 36 in. deep. These were designed with an exaggerated camber in the lower flange so that when loaded a residual camber offset the optical illusion of sagging. The upper connection of girder to column was riveted, but the lower connection was bolted, so designed that when drawn up the column was slightly distorted until the girders were loaded.

Air ducts, pneumatic conveyor tubes, wiring and plumbing pass through the webs of the girders. These openings were placed as near the neutral axis as possible, and were reinforced where necessary, especially when they occurred near the ends of the girders (Fig. 2). Crossbeams framing into the girders were tied across tops of girders by straps welded to the top flanges of the beams to provide continuity and thus reduce the depth of beam; bottom beam connections were clip angles riveted to the girder web but welded to the beam flanges (Fig. 4).

### Heating and air conditioning

Innovations in heating and air conditioning were worked out by Charles

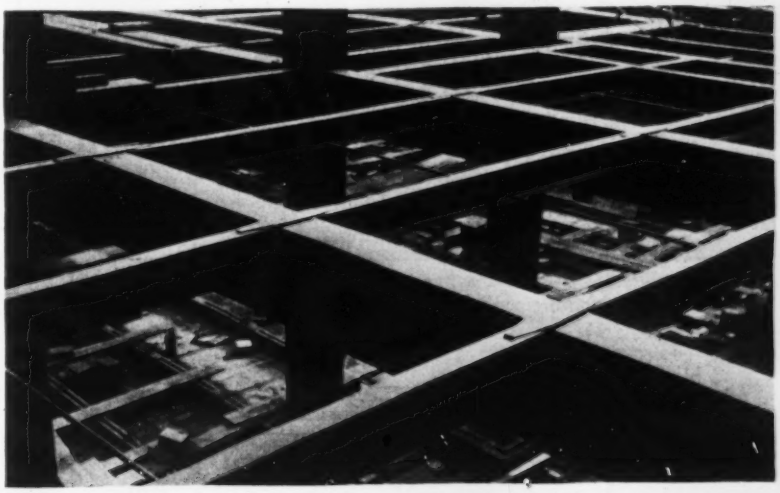


**Fig. 4.** To reduce weight and depth of members, steel framing was made continuous in all directions. At intersections of beams and girders tie plates were welded across the top for continuity, as shown here.

S. Leopold, of Philadelphia, consultant to the architects. Their first request to him was to eliminate radiators wherever possible, especially in the clerical areas, for hot radiators render areas around the units unsuitable as working space. Because of the temperature extremes of the Iowa climate, double windows were planned throughout, and all outside walls and roof areas are insulated.

The unusual heating system consists of 1-in. bare copper tubes looping under and around the window openings. In winter hot water will be pumped through the tubes to balance the heat loss through the double windows and 2 in. of cork insulation on the outside wall. During hot weather cold water will be forced through the tubes to keep the walls at temperatures just below that of the human skin, but never so low that body heat will radiate to the walls.

As the wall and window effect on inside temperatures has been eliminated, all other factors tend to increase the internal heat of the building. Lighting increases the sensible heat, and the occupants increase both sensible and latent heat. Consequently, to keep room temperatures at a predetermined level, air cooler than the room temperature will be introduced through a perforated metal hung ceiling. Thus the normal stratification of air temperatures resulting from radiator heating has been reversed. Acoustical material was applied to the underside of the flat tile arch; sound passing through the perforations in the metal ceiling is absorbed by this material, which also acts as thermal insulation for the ceiling. Details of a typical wall panel are shown in Fig. 5.

The heating and ventilating system is divided into four zones on each floor, each independently controlled by thermostats. As the temperature of the incoming air is controlled by booster heaters, a predetermined volume of fresh and recirculated air stays constant for proper ventilation.

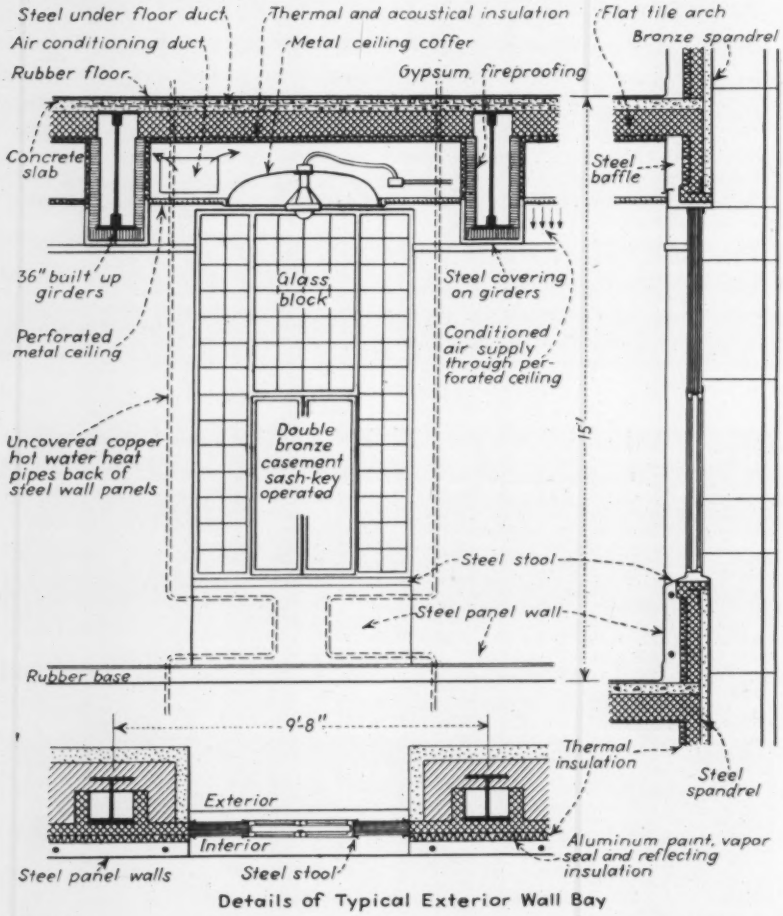



**Fig. 5.** Steel panel interior walls, perforated metal ceilings, bare copper hot water heat pipes and recessed lights are new building features. Walls and ceilings are also well insulated against heat and sound.

This heating arrangement led to an interesting development in interior wall finish in the clerical areas. Here the walls are covered by factory-enameled metal panels; all plaster has been eliminated. Tests showed the metal panels had better acoustical properties than plaster, and maintenance reports on similar installations in federal buildings in Washington show upkeep costs are only 20 per cent of those of painted plaster walls.

On the sixth or executive floor, both heating and ventilating is by air entering the rooms through grilles in the window stools in a constant volume. Booster heaters in each duct are controlled by thermostats in each room so the temperature may be varied as desired. As the entire air conditioning system was designed with the building, the ducts and intakes were made sufficiently large for a complete change of air every eleven minutes. During intermediate season the cool outside air, instead of refrigerated air, can be utilized to compensate for body and light heat gains.

## Lighting

The architects felt that customary indirect lighting from hanging fixtures would be inefficient because of the perforated ceilings, and furthermore the appearance of a great number of fixtures in the large working spaces would be unsightly. After considerable study the lighting system as developed by the Detroit Edison Co. for its new office building was adopted. This consists of coffers 4 ft. square recessed into the ceiling. From the center of each coffer hangs a short silver-bowl lamp, its neck brightness concealed by concentric metal rings. The lights, placed about 10 ft. center to center, and equipped with 300-watt bulbs, give an illumination of 32 footcandles at desk top.

## Direction

The writer's firm, Tinsley, McBroom & Higgins, Des Moines, are architects on the building. The general contract for construction is held by Arthur H. Neumann and Bros., Inc., Des Moines, and the work is under the direct supervision of Harold Neumann. Jones & Laughlin fabricated the 3,500 tons of steel, erected by the general contractor. Construction is proceeding under a well-organized program, and the building will be ready for occupancy late next spring.

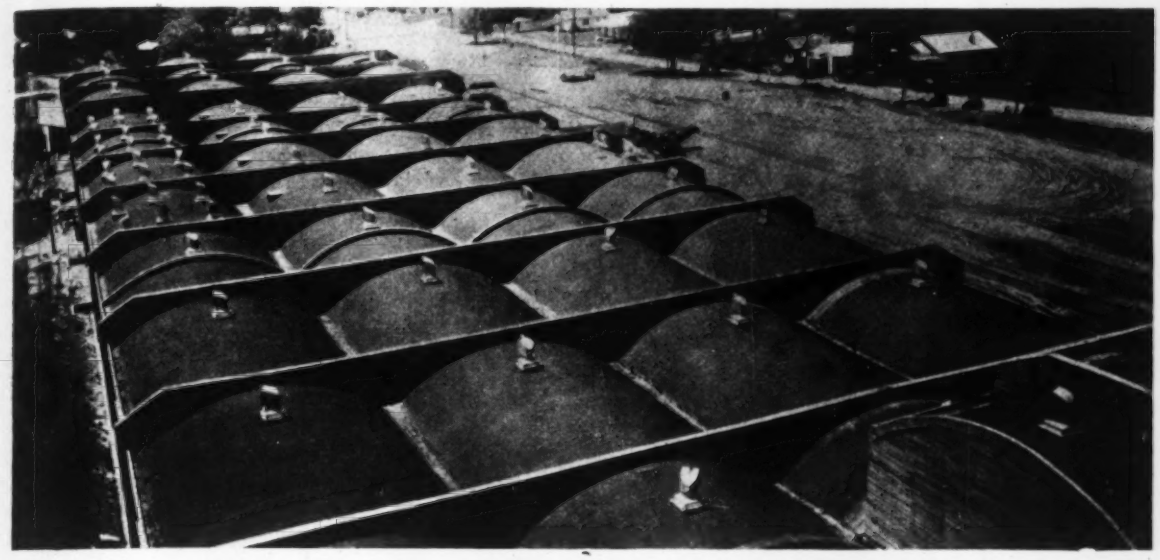


FIG. 1. THESE THIN-SHELL CONCRETE BARRELS COVER A NEW TIRE FACTORY.

# Tire Factory at Natchez

ANTON TEDESKO
Engineer of Structural Design, Roberts and Schaefer Co., Chicago

***Contents in Brief—Wide column spacing for large working areas made possible by long multiple-barrel roof construction in a new all-concrete factory for the Armstrong Tire & Rubber Co. Thin-shell concrete barrels carry outside stiffening ribs, leaving arched ceilings smooth for maximum light reflection. Structure built at low cost with local labor. Repeated use of plywood forms is a construction feature.***

A STUDY of competitive designs of mill building construction to meet space and layout requirements of the new Armstrong Tire & Rubber Co. plant at Natchez, Miss., resulted in selection by the owners of a monolithic concrete structure incorporating Z-D shell roofs in multiple-barrel arrangement. Beside a reduction in fire hazard, low insurance rates, low maintenance costs and high permanency, the adopted design offers a pleasing appearance and is free from obstructing trusses. Financed under the Mississippi Industrial Act and partly owned by the city of Natchez, the factory, constructed entirely by local labor, is now complete and is turning out 5,000 tires daily.

The main part of the factory, 160x 760 ft. in plan, is divided into a two-story receiving section at one end, a long one-story manufacturing hall and a two-story tire storage section at the opposite end. A one-story office building of 3,800 sq. ft. and a power house covering 2,600 sq. ft. are arranged on opposite sides of the factory proper.

## Multiple barrel roof

Requirements of the manufacturer called for a 50 and 60-ft. longitudinal and a 40-ft. transverse column spacing. Accordingly, it was decided to use for the major portion of the factory a cross-section as shown in Fig. 3, combining four segmental shells without the use of beams, girders or obstructing stiffening members within the building. This main portion of the factory is divided into units 75 ft. long separated by expansion joints. The roof shell of each unit spans between two transverse continuous frames. These stiffening frames are arranged above the roof shell (Fig. 1) and are supported by five columns.

One principal reason for the layout as chosen was that the smoothness of the arched ceiling and the longitudinal arrangement of arch bays permit the use of an inexpensive forming system. The centering and forms for the arched ceiling had to be erected only once and, after being lowered 1 in., could easily be shifted to the next position. Another reason for the cross-sectional shape of the factory was that the owner preferred its clear simple lines and a curved underside of the factory roof, which, without beams or struts to cast shadows, reflects the light sufficiently to save 15 per cent in illumination costs. Then, too, the shape of the arch roof bays, along each of which manufacturing units are located, is especially advantageous in the southern climate. Hot air accumulates in the crown of the bays, where ventilators are provided. The exhausted air, still being somewhat cooler than the warm outside air, stays above the roof in the valleys and pockets formed between barrels and provides considerable insulation.

Column foundations consist of spread footings on sound natural

**Fig. 2.** Transverse and longitudinal arrangement of barrel-roof bays suit manufacturing requirements. Two-story material receiving end is in foreground.

ground. Monolithic reinforced concrete walls, acting as concrete girders between footings, were formed with rough boards for architectural effect. The main floor of the factory consists of two-course 5-in. slab, finished with a rotary trowel. The second floor of the manufacturing and raw material receiving end, 160x160 ft., consists of flat slabs designed for a 200-lb. live load, with columns spaced 20 ft. each way. At the opposite, or finished tire storage end of the factory, 150x160 ft., the beams and slabs were designed for a live load of 50 lb. per sq. ft. with columns spaced 16 ft. 8 in. in one direction and 20 ft. in the other.

For construction reasons, the flat slab of the receiving end was constructed first and the roof afterwards, but at the two-story storage end the roof with its columns was constructed first and the second-story beams and slabs were constructed under the finished roof, supported by brackets on the roof columns and by intermediate stub columns. This procedure permitted construction progress under the finished roof during bad weather. Concrete platforms, 12 ft. wide and totaling 300 ft. in length, covered by canopy roofs, were built at four locations at receiving and loading ends of the factory.

All concrete slabs and the concrete roof were designed to support an elaborate system of conveyors and machinery. The concrete shell is better adapted than are conventional designs to take care of unforeseen future loads due to manufacturing requirements, for the shell, with its dome-like action, has a better reserve for excess loads than have reinforced concrete systems spanning in one direction only. Suspended loads at various points can be taken care of with slight redistribution of stresses in the roof, all parts of which participate in the structural action.

### Shells are 3¼ in. thick

The concrete shell roof slabs, all 3¼ in. thick, and built to a 30-ft. radius, are rigidly held by each other, by the frame beams or stiffening ribs above the roofs and by the monolithic walls to which they connect. Roof loads are transferred by a system of direct stress paths to the supporting frames. As in a system of intersecting parts of cylindrical pipes, they act as an enormous corrugated concrete sheet, or a 50-ft. span beam system between arch frames and a cantilever of 25 ft. beyond such frames. Machinery and other loads on inserts in the roof necessitated the arrangement of stiffening ribs at the free edges of the cantilevering shell slabs. The carrying action of the shells of this design was more fully covered in *ENR*, Apr. 8, 1937, p. 505.

Fig. 4 shows the stress distribution along the cross-sectional curve of the barrel shell in the center of a 50-ft. span assumed to be freely supported. Diagram "a" shows the direct stress in longitudinal direction, being compression near the crowns, tension in the neighborhood of the valleys, and thus illustrating a longitudinal beam action.

The diagram "b" is characteristic of the transverse arch bridging action and shows what may be termed an arch thrust. This thrust is large at the crown but very small at the exterior walls, since these walls are too flexible to act as abutments for an arch action. According to the theory of least work, the roof system will carry most stresses longitudinally since a longitudinal beam action of the system can be accomplished with less deformation than a pure arch action would require. Diagram "b" also shows that the arch thrust in the valley lines is negative, which means that the two neighboring shells do not brace themselves against each other but that the load of the valley part of the roof rather hangs from the adjoining stiff pipe shells. Diagram "c" shows the distribution of transverse bending moments over the

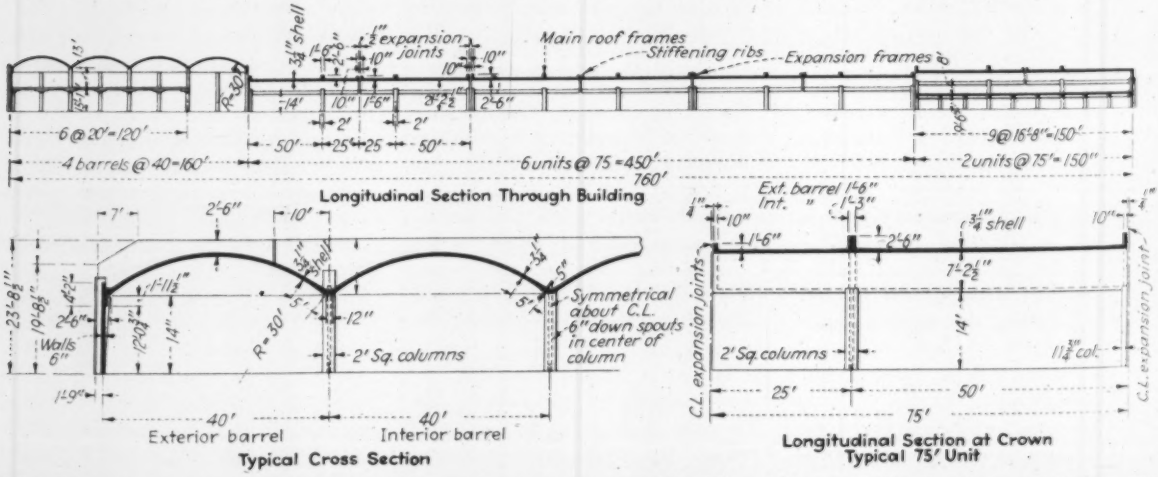



**Fig. 3.** Sections of full building and typical roof unit show general building layout and details of monolithic concrete design. The roof units are four barrels wide and 75 ft. long.

cross-section. The details applying to the strengthening of the concrete shell on account of restraining moments are shown in Fig. 3.

### Formwork

For the construction of the roof enough centering and formwork was provided to take care of the pour of one roof unit, 160x75 ft. A second similar set of centering was added in the fall of the year to speed up the construction for an early finish of the factory. All scaffolding was supported on concrete subfloors before the application of the floor finish. Centering of each roof bay consisted of a timber framework supporting curved timber trusses 12 ft. apart. Between posts and trusses screw jacks were inserted for form adjustment and to aid striking the forms. From truss to truss, wood joists were placed 2 ft. c. to c. to support $\frac{3}{8}$-in. plywood sheeting, curved to the inner radius of the shell. The edges of the plywood were protected by sheet metal strips, which kept the plywood in good condition despite repeated use. Reinforcing was placed on the roof forms in several layers consisting of $\frac{3}{8}$-in. and $\frac{1}{2}$-in. round bars which, though furnished straight, could easily be curved to place to follow the lines of stress. Concrete spacer blocks provided for the correct clearances of reinforcing bars and of beam frame forms above the roof.

The concrete mix called for 1.6 bbl.

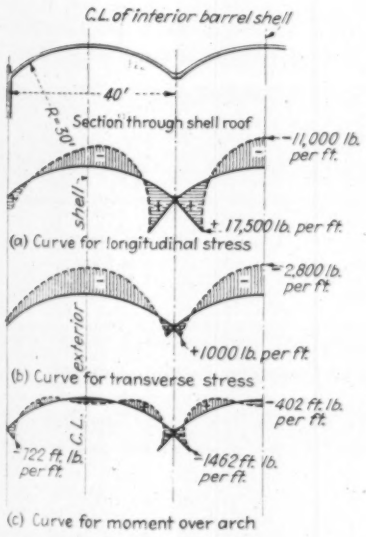



Fig. 4. Diagram of stresses in shell roof. Stresses as shown are in the center of a 50-ft. barrel span, assumed to be freely supported at both ends.

of high-early-strength cement per cu. yd. Aggregates were delivered by truck. Concrete, mixed in a paver, was raised to the roof by a two hoist tower at the head of each roof unit to be poured, connected with each other and to the roof by runways. Continuous pouring proceeded in each of the four roof bays independently, the concrete being transported by buggies along runways at the crown of each roof barrel. The mix, of consistency stiff enough to eliminate top forms, was chuted and shoveled into place (Fig. 5).

The roof surface received a float finish to which a three-ply built-up roofing with mineral surface was applied. Expansion joints were flashed with copper.

### Decentering and form stripping

The time of striking the centers depended on a test cylinder strength of 2,500 lb. and on a certain load-deflection relationship of small test beams made of each roof pour and tested in bending. The forms were stripped and the centering trusses of each roof bay were lowered about 1 in. by means of the screw jacks. Whenever the curved plywood did not readily come loose from the roof slab a jet of water applied between forms and concrete immediately brought the desired result.

The form panels in the valley lines between columns were taken down in panels, while each bay of the scaffolding was placed on pipe rollers and was pulled out with a hoist from underneath the finished unit into its next position where the forms were again lined up and adjusted as to correct elevation. Columns were poured ahead of the roof slab. Downspouts were placed within columns. The described procedures were repeated in cycles of approximately ten days. The lowering, moving and readjusting of formwork could be accomplished within one day.

In accordance with manufacturing requirements the roof barrels above the receiving and raw material storage end were arranged transversely instead of longitudinally. Though the column spacing is 60 ft. for this portion of the factory the same roof centering trusses could be used. The forms were re-erected on the second floor and were shifted from one side of the building to the other side, with only two uses at this end.

The requirements of the manufacturer made necessary the installation of over 100 ventilators, 24-in. and 30-in. diameter, also transformer rooms, air conditioned offices, locker rooms, stairs, tunnels, chimney, independent machinery foundations, steam and water lines, domestic and stormwater systems, pump pits, etc.

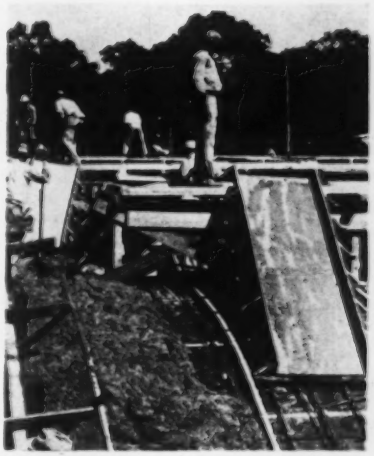


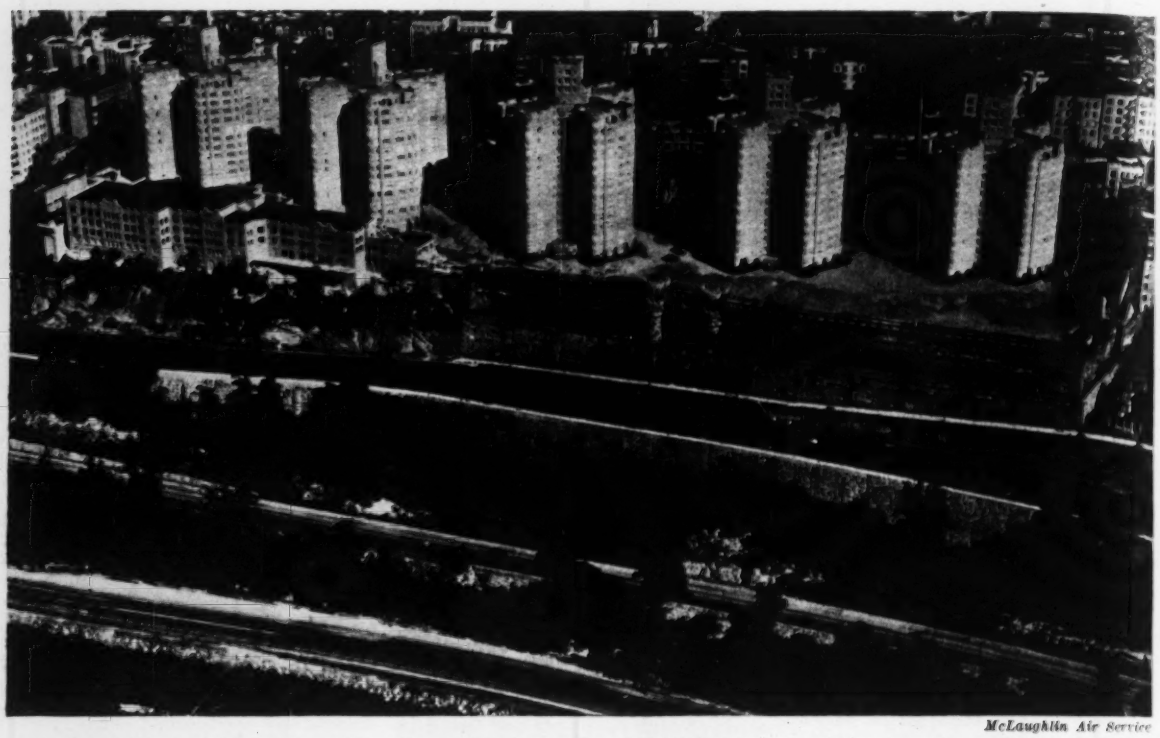
Fig. 5. Concrete for the thin shell roof units was mixed stiff enough to eliminate top forms, and was placed from runways on the arch crowns.

### Unit cost unusually low

Labor rates were low; however, the well laid out forming system and many re-uses of forms account for the low cost of this fireproof and permanent building. The contract amounted to $170,000, less than $1.00 per sq. ft. of usable floor area, and included the completed building with the exception of the mechanical trades. This price is 6c. per cu. ft. Although these unit costs are low a similar building in a territory where union labor rates were paid cost only $1.50 per sq. ft. and 6.5c. per cu. ft.

### Personnel

The manufacturing and mechanical layout was by the Armstrong Tire & Rubber Company, J. A. Walsh, president; F. E. Honderich, chief engineer. The City of Natchez was represented by its mayor, W. J. Byrne. J. T. Canizaro was local architect for the development and Roberts and Schaefer Co., consulting engineers, Chicago, made the design and supervised the construction of the factory. The Z-D system of roof structure was used under license from Structural Shell Designers, Inc., Chicago. B. L. Knost, Pass Christian, Miss., was general contractor.



McLaughlin Air Service

FIG. 1. CASTLE VILLAGE—FIVE BUILDINGS AND A GARAGE—OVERLOOK THE HUDSON RIVER FROM A HIGH BLUFF.

# Apartment Housing, New York

***Contents in Brief**—An outstanding apartment building job in New York during the current year is Castle Village, located on a bluff above the Hudson river on far upper Manhattan Island. Of 11 to 13 stories, an unusual height for reinforced concrete dwelling construction, the five buildings have a Maltese cross floor plan which affords a maximum view of the river. The buildings include an unusual type of sound-proof wall and flexible copper tubing riser-radiator connections.*

MULTI-STORY reinforced concrete construction, adjoining fireproof garage, and a floor plan layout that gives maximum visibility of the Hudson River combine to make Castle Village Apartments in New York outstanding among private housing developments of 1939. Fireproof construction is the exception rather than the rule in the upper reaches of Manhattan, and this is the first multiple dwelling project in the city to be built with a large garage on the premises. A Maltese cross floor plan makes the river visible from eight of nine apartments on every floor.

The apartments are located on Riverside Drive 200 ft. above the Hudson a few blocks north of George Washington Bridge on the site of Dr. Charles V. Paterno's former town house, "The Castle," long a landmark on the rock escarpment. Dr. Paterno is the owner of the $6,000,000 project.

Five buildings and a garage on a rectangular site sloping downward along the river from north to south make up Castle Village (Fig. 1); the three buildings at the left (north) are 13 stories, the fourth is 12 stories and the fifth is 11. The garage also shown at the left is built on the river side.

Buildings occupy but a small percentage of the plot area. The Maltese cross floor plan was developed to take full advantage of the light and ventilation available at the exposed location. The roofs of the two west wings of each unit will be used as sun decks 300 ft. above the river, and terrace apartments are provided on the top floors of these wings. Each apartment has a triple corner window. There are 468 living units and more than 2,300 rooms.

Access to the apartments of each unit is provided by two passenger elevators, one freight elevator and two stairways. Elevator operation is by full automatic push-button control. Speed is 250 ft. per min. with an 1,800-lb. load. Cupolas atop the buildings contain wood water storage tanks and elevator machinery.

The garage is a three-story reinforced concrete ramp structure; it will house a restaurant and recreation rooms on the lower level and automobiles on the two upper levels.

## Structural frame

Reinforced concrete construction was chosen for the structures in preference to a steel frame with cinder

concrete floor arches. This type of construction eliminated furred ceilings—an important consideration in fine apartment construction—and it allowed a lower story height, which cuts down the building height almost a full story in the 13-story units.

Foundations presented little difficulty due to the presence of rock near the surface over the entire site. However, because rock depth varied greatly, design of column footings and basements proceeded only as fast as the overburden was removed. Heating plants, of which there is one for each building, are not located in the same position in each building because of this variable rock depth. Footings were designed for a pressure of 25 tons per square foot on medium rock, which gave an average area of 24x48 in.

Columns vary from 12x12 in. to 12x68 in. The constant 12-in. dimension makes it possible to limit column offsets into rooms to 4 in., with a 4-in. minimum wall thickness. The long dimensions of columns run in the same direction as the long dimensions of rooms in order to keep beam lengths to a minimum. Most beams are 12x18 in. with a maximum length of about 20 ft. Heaviest reinforcing consists of two 1¼-in. square bars. The one-way floor slabs range from 4 in. to 6½ in. in thickness. Concrete was specified at 2,500 lb. per sq. in. for the columns and 2,000 lb. elsewhere.

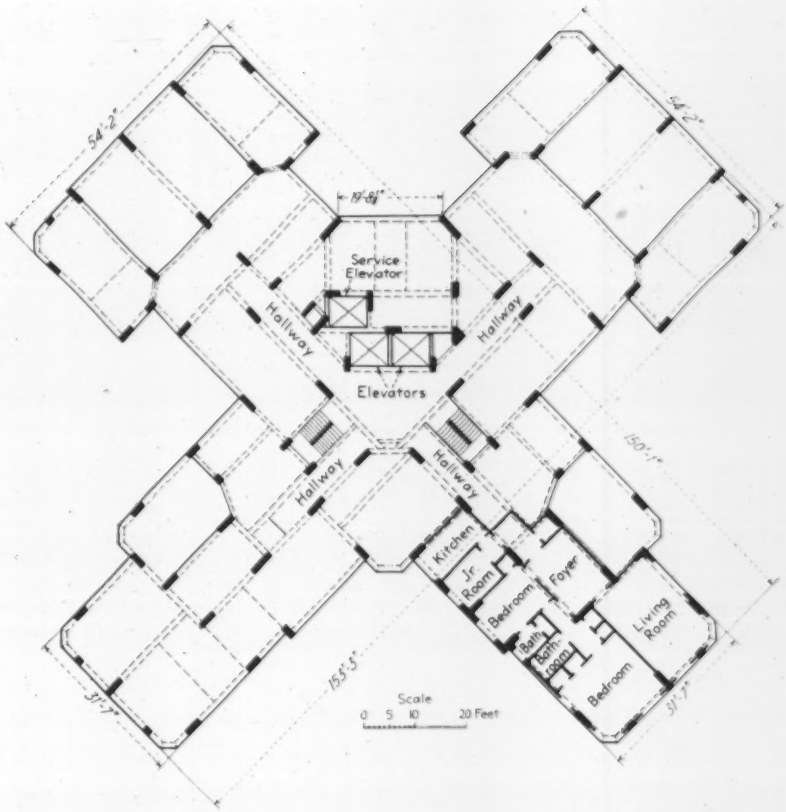



**Fig. 2.** Floor plan used throughout the units, showing column and beam locations. Columns are shaped so as to reduce beam length. A typical apartment layout is included.

## Walls

Exterior walls are 12 in. thick, made up of 4 in. of shale brick (adopted because of a claimed absence of efflorescence) and 8 in. of terra cotta hollow tile. Although the New York building code allows 10-in. walls for this type of apartment construction, the 12-in. thickness was chosen because it is possible to place the insulated steam heating risers in the wall without furring out around them.

Inter-apartment walls utilize unique construction for soundproofing (Fig. 3). In addition to a sound-absorbing dead air space, an independently hung diaphragm plaster surface is used, which acts to reflect sound vibrations rather than to transmit them to the frame and the interior partition of 2-in. gypsum block. The construction involves a panel of metal lath attached top and bottom by spring clips and stiffened with T-rods. Spring clips also support the metal lath against the block partitions. Moldings and baseboards were nailed to the wall diaphragm *only*, covering up the gap around the edge without providing a contact with the frame through which sound could be transmitted. Intra-apartment walls are 3-in. gypsum block plastered direct.

## Floors and roof

Apartment floors are of prepared hardwood parquet units laid in a mastic spread directly on the concrete floor slab. Around the edges of the floors and under the baseboard is a 1-in. cork expansion and contraction joint. Kitchen floors are of linoleum, and bathrooms have tile floors.

But for plasterers' union objections, smooth plywood ceiling forms would have made it possible to omit plaster from ceilings. The obvious advantages of this type of construction as originally planned are the saving in plaster cost, the elimination of danger from falling plaster and the elimination of plaster cracks. However, the unions refused to take the job of plastering walls only. Only projecting girders and columns were not plastered.

The roof slab is topped by a 1½-in. layer of gypsum roofing insulation. On top of this an asphalt and slag or cinder-fill tile surface is used, depending upon the use to which the particular area is to be put.

Windows are double-hung six-pane wood sash of a special type in which the counterbalance is contained entirely within the limits of the sash itself. This design eliminates weights, cords and pulleys and makes it possible to reduce mullion width to an absolute minimum. As a result of this latter feature a maximum of light is admitted through the triple corner windows.

The choice of wood sash instead of steel was influenced by the high winds of the exposed location. Steel swinging casements market at a slightly lower figure than do the double-hung wood sash, but in order to avoid high pane-breakage in the steel type due to swinging in the wind it would be necessary to tighten the hinges to a point where opening and closing would be quite difficult.

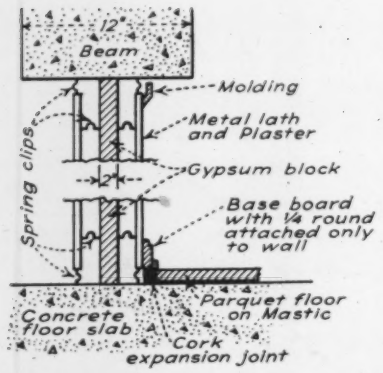



**Fig. 3.** Inter-apartment walls of gypsum block are soundproofed by use of spring-hung plastering diaphragms. A cork expansion joint extends under the baseboard all around the parquet floor.

All exposed hardware and other metal work is galvanized against the ravages of salt air. Ornamentation trim is of cast stone.

### Heating

The five buildings and the garages are heated by modulated thermostatically controlled steam systems. These systems consist of two boilers in each house, which supply steam through basement mains to the vertical risers feeding the radiators. Radiators are of the copper fin type, concealed under window sills in sheet-iron enclosures. The steam for the garage, restaurant and playrooms is supplied from the two apartment buildings nearest the garage building. Garage spaces are heated by thermostatically controlled unit heaters, and the restaurant, kitchen and playrooms are heated by direct radiators; they also are provided with a complete system of ducts and fans for air conditioning.

The steam boilers have been provided with submerged copper coils for heating the hot water which is stored in tanks above the boilers. Boilers are fired with oil burners which were installed to operate them at 125 per cent of their normal load. The temperature of the apartments is controlled by automatic control systems which can be regulated to vary the steam supply to the apartments as the outside temperature changes.

Steam that is supplied to the apartments is regulated by four pneumatically controlled valves on the steam mains of each building and by adjustable orifice valves on the radiators. These adjustable orifices are set to supply the exact amount of steam required by individual radiators without supplying an excess quantity of steam which might pass into the returns and the return risers.

### Flexible radiator connections

The reinforced concrete construction of the building required that the position of the steam risers be fixed, as the sleeves for these risers could only be located to pass through the center of the spandrel beams. With the risers in this position, it was not possible to use the standard swing joints in radiator connections, as the fittings required for these swings would have been exposed in the apartments. The swing joints which have previously been required to take care of the expansion and contraction of the risers were eliminated by substituting radiator branches of soft copper tubing of the proper length so the movement of the riser would bend the copper tubing without breaking any connections or moving the radiators. It has been found that this departure from standard practice represents a marked improvement over the old design of radiator branches. Less space is required for this connection; the tubing will bend more readily than the swing joint with fittings; and the labor required for making these connections is reduced materially.

The restaurant and playrooms have been provided with a complete fan and duct system for air conditioning, with the fans and coils in the basement. Where possible, the air has been supplied through anemostats to give even distribution of the conditioned air. Where it was not possible to fur-in the ducts in the ceilings, directional-type supply grilles have been installed in the walls. Recirculating ducts have been installed from these spaces to the supply fan, and a separate system of exhaust ducts with fans has been installed to remove smoke and take care of the excess air supplied by the system. A separate system of supply and exhaust ventilation has been provided for the kitchen and serving spaces.

### Electric facilities

Each of the five apartment buildings is supplied by separate 4-wire, 3-phase service through a master meter. At the service entrance of each building, a main switchboard with fused knife switches has been installed for all light and power feeders. Main light feeders from the switchboard supply cutout panels on all floors to which the circuits from the apartments are connected. No tenant meters have been provided as the owners supply current to the tenants without charge. However, provision has been made at the cutout panels for connecting meters to check the current consumption of each apartment.

Each apartment is equipped with an intercommunicating telephone which is connected through a main telephone switchboard in each elevator lobby. While these telephone systems will be used primarily by the attendant in the first floor lobby, they are so connected that any tenant can communicate with the manager, superintendent, engineer and laundry, or telephone the garage for the delivery of cars.

### Plumbing

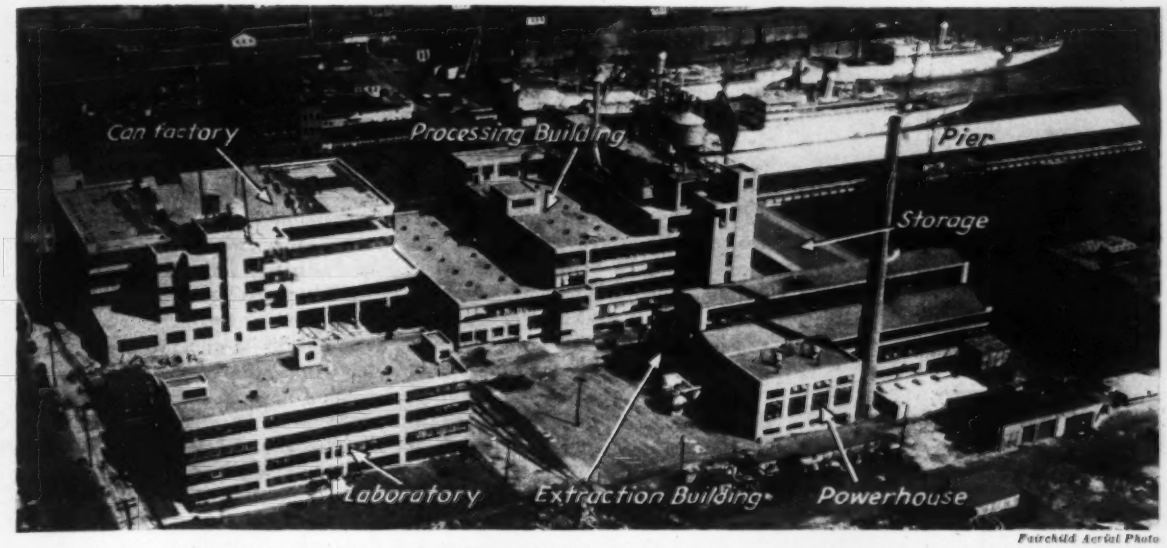
For this group of buildings a private sewer was installed to accommodate all of the apartment buildings. The garage is connected with a separate sewer into the Riverside Drive drainage system. Cold water is supplied to the buildings through three services and raised by house pumps to wooden roof tanks in the penthouses.

The cold water and hot water distributing mains are located in the top floor ceilings, and supply all fixtures through downfeed risers with circulating return mains in the basement. All cold and hot water piping is of red brass with a copper content of 85 per cent.

### Supervision

Construction of the project was executed under the direction of Everett Winters, supervisor for Dr. Paterno. George Fred Pelham, Jr. was architect for Castle Village, and Victor Mayper was engineer. Daniel and Wallen, Inc., designed heating, plumbing and electric facilities.

There was no general contractor for the job, as the Paterno organization let all contracts directly. The Walter Kidde Construction Co., Inc., New York, was concrete contractor. Charles W. Knowles is Kidde general superintendent and E. G. Robbins was superintendent in charge of the job.




Fairchild Aerial Photo

FIG. 1. NEW PLANT FOR MAXWELL HOUSE COFFEE, LOOKING NORTH ACROSS THE RIVERFRONT SITE.

# Coffee Roasting Plant in Hoboken

***Contents in Brief**—Largest and most modern coffee plant in the world receives coffee off the boat in sacks and ships it, ready for use, in cans made on the premises. Five buildings are steel frame and two of reinforced concrete, flat-slab construction; all are on concrete piles. Live loads vary from 250 to 2,000 lb. per sq. ft. on concrete floors in which several thousand inserts for machinery had to be placed. Piles under 50-yr.-old pier support new shed.*

CONSOLIDATION by General Foods Corp. of widely scattered coffee processing operations and research activities in a new plant on the Hudson River waterfront in Hoboken, N. J., opposite New York City, gave rise to one of the outstanding building operations of the year. Seven separate buildings have been built on a 9-acre tract of made-land formerly occupied by railroad yards. Supported on concrete piles, and of both reinforced concrete and steel construction, the buildings, both single and multi-story, provide a floor area of about 500,000 sq.ft. which accommodates the most modern equipment for handling, mixing, roasting and packing 600,000 lb. of coffee daily.

Grouped in a square, as shown in Fig. 1, the buildings are respectively the pier shed, the storage building, the processing building where Maxwell House coffee is blended, roasted, ground and packed, the extraction building where caffein is removed from the beans used for Sanka and Kaffee Hag coffees, the power house, the laboratory and the can factory. Excepting the pier shed and storage unit, whose walls are of cement-asbestos sheets, all buildings are faced with buff iron-spot face brick in bands that alternate with bands of steel sash continuous around the corners, this particular brick being chosen to match that used in the approach structures of the nearby Lincoln Tunnel; in all, 2,000,000 brick and 71,000 sq.ft. of sash and glazing are required. Sills and copings on all buildings are of precast concrete.

The plant was designed and built by the H. K. Ferguson Co., Cleveland, whose engineers worked with those of the owner not only in developing the structures and building them but in improving, planning and installing the production equipment. Theodore K. Rothermund was project manager for the builder.

### Preparing the site

Of first concern in the design were the foundation conditions. The entire site was found to be a fill, which had been placed to extend the old shoreline of the river about 400 ft. into the stream. Pile foundations, therefore, were necessary, and particularly so since the structures had to be designed for floor loads of from 250 to 2,000 lb. per sq.ft. Raymond step-tapered type concrete piles were chosen in order to assure maximum support in the Hudson River silt, and some 16,000 ft. of such piling was used. Most of the pile driving was relatively easy, but in the area of the can factory many large boulders were encountered which complicated the work considerably. Although basements are used in some of the buildings, none of them is excavated much below the prevailing ground level because of the soil conditions.

Another item in site preparation was the construction of a steel bulkhead along the shoreline. Anchored to concrete sleepers, this bulkhead forms a wharf for tying up lighters that bring miscellaneous cargo to the

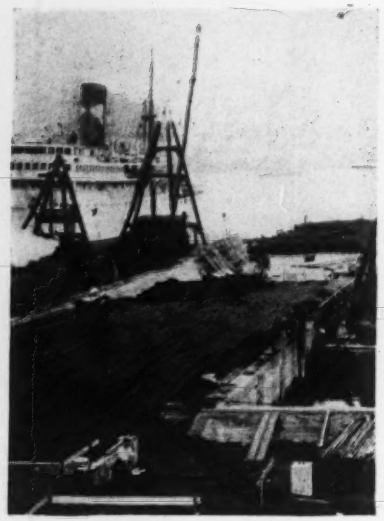


**Fig. 2.** Rolling cinder fill in a new pier structure built on top of existing timber piles 50 yr. old.

plant. Considerable dredging followed construction of the bulkhead to make this wharf accessible.

One of the most ambitious items of site preparation was the reconditioning of an old wooden pier, 60 ft. wide by 522 ft. long, built about 1888; a pier being an essential part of the plant, so that vessels, bringing green coffee from South America, can anchor and discharge their cargoes into storage. The old pier presented a very dilapidated appearance but the timber piling was found to be in good condition at and below mean tide level. The wooden superstructure, therefore, was torn down, and the piling cut off with an underwater saw 1 ft. below mean tide. On this cut-off piling a continuous decking of 6-in. plank was laid, and a reinforced gravity type retaining wall built on it around the perimeter of the pier. This retaining wall was to support a pier shed 68 ft. wide and in addition to retail a fill of clean boiler-house cinders upon which the reinforced concrete pier floor, designed for 600 lb. per sq.ft. live load, could be placed. The cinders were clamshelled into place from a barge, spread in thin layers and compacted with heavy road rollers. Rebuilding of this old pier into a modern fire-resisting structure was one of the outstanding accomplishments of the project.

## The steel frame buildings

Five of the seven buildings have steel frames, two of mill type and three of special type to fit particular requirements, and involving a total of 1,300 tons of structural steel. The mill-type buildings are the pier shed and the storage warehouse, both of clear span, 68 and 120 ft. respectively. The warehouse is 384 ft. long parallel to the shoreline and is equipped with a monitor roof. Sidewalls and roofs of both buildings are of corrugated cement-asbestos sheets, although brick is used in the warehouse from foundation to window sills, and overhead counter-balanced steel doors inclose one side of the pier shed. Taken together, these two buildings provide storage for 20,000,000 lb. of green sacked coffee.

Of the three other buildings, one, the laboratory, is a conventional 4-story tier-type structure, 70x170 ft. in plan, with timber floors, while the other two, the extraction building and the boiler house, have special functional frames. The extraction building was built to house the equipment necessary for removing the caffein from the green coffee bean, and contains four checker plate steel floors at various levels. It is 89 ft. wide and 214 ft. long and has a monitor roof. The boiler house, about 50x50 ft. in plan, is framed with clear-span trusses. Much of its interior steelwork is used to support the two oil-fired boilers.

Roofs of these last two buildings are structural gypsum plank, while walls are solid brick, 12 in. thick—iron-spot brick on the exterior backed by sand-lime brick. Relieved by precast concrete sills and copings, these walls, which are also used on the coffee processing building and the can factory, give the plant an integrated appearance.

## The concrete frame buildings

Heavy, large-scale manufacturing operations are confined to the 6-story processing building and the 4-story can factory, which are of reinforced concrete flat slab design, in panels 20 ft. square, with circular columns of a maximum diameter of 32 in. Floor slabs in the processing building are cantilevered 8 ft. beyond the column lines on the north and south walls.

Both buildings accommodate a straight-line gravity-flow manufacturing operation. In the processing building, for example, coffee is received from the dock and warehouse into the east end of the basement and is carried by elevators to the roof, from where it flows by gravity through the cleaning, blending, roasting, grinding and packaging processes until it arrives on the first floor where railroad loading facilities are provided on the west elevation and truck loading facilities along the north elevation. In both buildings, too, access facilities are kept clear of the manufacturing floor by confining stairs, fire towers and elevators to outside enclosed shafts. The freight elevators, of which there are two of 12,000-lb. capacity in the processing building and one of 15,000-lb. capacity in the can factory, are equipped with micro-leveling devices that hold

**Fig. 3.** As five steel frame and two concrete frame buildings for the coffee processing plant were being constructed simultaneously on a 9-acre site across the Hudson River from New York's skyscrapers.

the platform level with the floors under all conditions of loading.

Of the two buildings, the processing building is the more simple since all of its floors are alike, being designed for 250 lb. per sq.ft. live load. One distinction that it has is provision for increasing its size by building up on the setbacks, the roofs of these setbacks being designed as future floors for full live load, while the columns for the future additions extend through the roof slabs as shown in Fig. 1. As roofs, the slabs are covered with a tar mastic sprinkled with slag.

The factory for making the vacuum cans in which the company's coffees are packed is an unusual element of the plant. Adjoining the processing building on the west, it contains 113,245 sq.ft. of floor area and, as stated, is four stories high. Its reinforced concrete construction ends at the fourth floor and steel framing is used for the upper structure and the sawtooth monitor roof.

In constructing this building every effort had to be made to avoid disturbing the piling foundation of the completed processing building. The columns adjoining this building bear on cantilever beams resting on two rows of pile caps at their inboard ends. This expedient made it possible to keep the can factory pile driving operations at a maximum distance from the processing building. There is no basement in the can factory, and the foundation walls were designed with tension ties to the interior pile caps so that they could retain a sand fill upon which the first floor is laid.

This first floor slab is designed for a live load of 2,000 lb. per sq.ft. It is 7 in. thick, reinforced with 4 x 4 No. 2 gage welded wire mesh. At the expansion joints the slab thickness is increased to 9 in., and ½-in.-diameter dowels on 2-ft. centers run through the joints, which are filled with ½-in. premolded mastic.

The second and third floor slabs of the can factory are 10½ in. thick and designed for a 300 lb. per sq.ft. live load. The first and second floors have a ¾-in. cement finish, while a wood block wearing surface is used on the third and fourth floors, the latter being a 12½-in. slab designed for 500 lb. per sq.ft. Roofs are gypsum planks.

One of the unusual requirements in the can factory, as well as in the processing building, was provision of inserts and holes in the slabs for equipment. On the second floor of the can factory, for example, there are 550 inserts set in the ceiling for anchoring can bins, while in the third floor ceiling there are 2,560 of these inserts. All provisions for equipment anchorage and for pipes and inter-floor chutes were made in the original design, so that the forming and pouring of the floor slabs for these buildings was a complicated operation.

This new coffee processing plant is now in full operation, and official dedication ceremonies were held on Oct. 13, with an "open house" celebration on the following day.

# Power Plant for Holland, Mich.

R. F. GIFFELS
Giffels & Vallet, Inc., Detroit, Mich.

***Contents in Brief**—Small steam power plant of 15,000-kw capacity is built on steel piles on marshy riverbank site to be assured of adequate condensing water and coal delivery by barge. Steel frame enclosed in 25-in. brick and tile walls and insulated cement tile roof makes up structure, which is 83x140 ft. in plan. Boilers and condensers on mat foundations separate from building. Main floors are concrete, operating platforms steel grating.*

INSUFFICIENT condensing water and inefficient boilers and generators, as measured by modern standards, led the city of Holland, Mich. (population 15,000) to undertake the construction of a new power generating station to replace its old municipal plant, built in 1930. Now under construction, this new plant, with 15,000-kw generating capacity, will enable the city to meet a power demand which has been steadily increasing. In layout and design the power plant building is as modern as the equipment that it will house and is one of the outstanding buildings of its type of the year. Not including the cost of land or necessary filling, the cost of the project will be about $1,390,000.

### Riverside site

Located downstream from the old plant, the new plant is being built on a 10-acre site at the junction of the Black River with Lake Macatawa. Most of the area lies within the former shoreline of the lake but the power plant site has been filled with sand to an elevation about 2 ft. above the highest recorded lake level, fill coming from dredging operations in connection with a new, enlarged

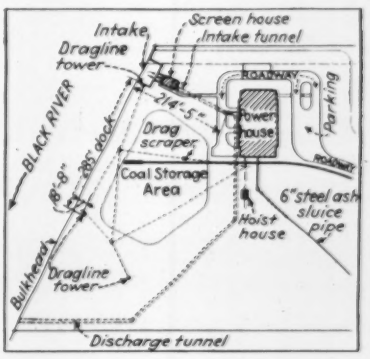



Fig. 1. Layout of plant and facilities on bank of the Black River.

ship channel in the Black River which is being cut to a depth of 18 ft.

A bulkhead extends across the entire frontage of the site on the ship channel, and for about a third of its length it is topped with a coal wharf structure, 285 ft. long and 18 ft. 8 in. wide. The bulkhead, of steel sheet-

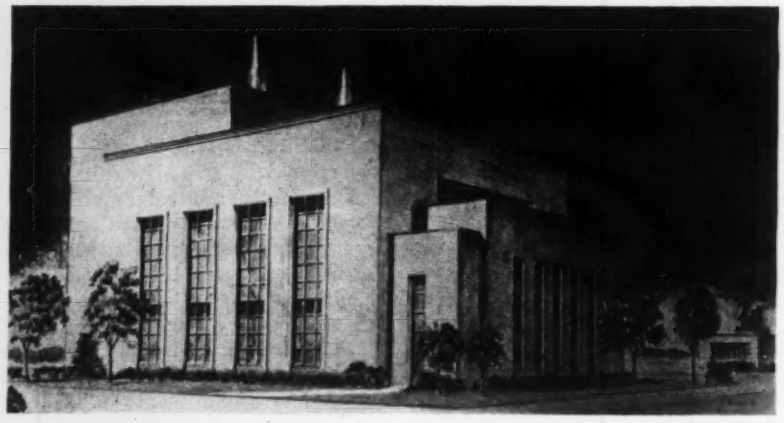


**Fig. 2.** Architect's sketch of power plant, with roof levels from high to low corresponding to boiler house, turbine house and switch house. Small structure at right is screen house over intake tunnel.

piling topped by a concrete slab 26 in. thick by 5 ft. wide into which the piling extends 2 ft., is anchored by pairs of 2¼-in. wrought iron rods spaced 14 ft. on centers attached to a 4-ft.-square continuous concrete beam 70 ft. back from the bulkhead. The beam is supported at 14-ft. intervals by groups of three wood batter piles 65 ft. long.

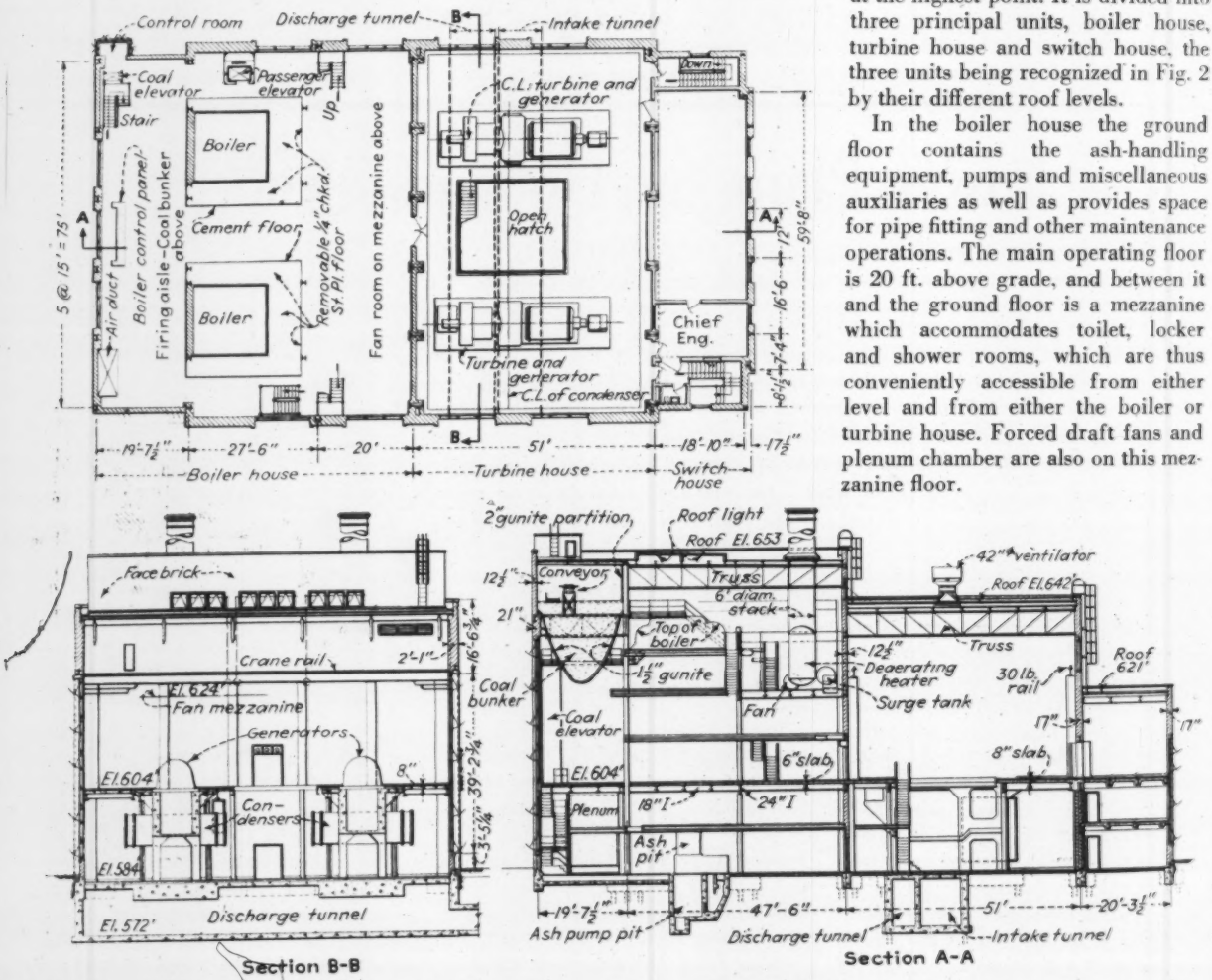



**Fig. 3.** Floor plan and sections of 15,000-kw power plant for city of Holland, Mich.

The principal elements of the plant are: the power house; the coal wharf; a coal-handling dragline system; and a circulating water system, including intake and discharge tunnels and a screen house. The arrangement of these elements on the site (Fig. 1) was largely governed by requirements for storing 20,000 tons of coal to be brought in by boat, or in case of emergency, by rail. Another requirement of the layout was to place the circulating water tunnels so that the discharge of warm water would be downstream from the intake. It was also necessary to locate the tunnels so as to keep them clear of the coal storage area since the weight of the coal will probably cause ground settlement.

### Power house plan

The power plant building, of structural steel with brick enclosing walls, is 83x140 ft. in plan and 70 ft. high at the highest point. It is divided into three principal units, boiler house, turbine house and switch house, the three units being recognized in Fig. 2 by their different roof levels.

In the boiler house the ground floor contains the ash-handling equipment, pumps and miscellaneous auxiliaries as well as provides space for pipe fitting and other maintenance operations. The main operating floor is 20 ft. above grade, and between it and the ground floor is a mezzanine which accommodates toilet, locker and shower rooms, which are thus conveniently accessible from either level and from either the boiler or turbine house. Forced draft fans and plenum chamber are also on this mezzanine floor.

All of the space above the operating floor in the boiler house is occupied by two boilers and auxiliary equipment. Operating platforms and walkways are provided at various levels. In front of the boilers, in the firing aisle, space overhead is occupied by a gunite-lined parabolic-shaped steel coal bunker of about 200 tons capacity. The space above the bunker is separated from the boiler room by a gunite partition and kept under negative atmospheric pressure by connection to the furnace air duct to prevent seepage of dust-laden air into the boiler room. In addition to two stairways, the boiler house is provided with a 3x5-ft. electric passenger elevator serving all levels.

The turbine house in the center of the building is two stories high with floors at the same level as in the boiler house. The ground floor contains condensers and auxiliary equipment and the concrete foundations for the turbo-generators. The circulating water intake and discharge tunnels are below the ground floor and run transverse to the building. The turbo-generator units are located on the upper floor, which is served by a 30-ton overhead crane. An open well between the turbo-generator units allows the use of the crane in handling condensing equipment on the ground floor, and a removable hatch in the upper floor permits the crane to handle equipment direct from trucks, which can be driven onto the ground floor.

The third unit of the power plant is the switch house, which, although lowest in total height, contains three stories. Two stairways provide communication between the various levels of both the switch house and the turbine house. In addition to housing switch gear and battery rooms, the switch house contains the chief engineer's office. The main entrance to the building is into the stair hall of the switch house and then to the chief engineer's office or turbine room.

### Construction elements

The power house building is supported on 12-in. 53-lb. steel H-piles designed for 50-ton capacity. The piles average 65 ft. in length and were driven through strata of sand and clay into a stony structure approaching hardpan. Column footings are individually supported on these piles while large groups of them are used under the concrete mats that carry the boilers and the turbo-generator units.

Floors in general are reinforced concrete slabs. The ground floor, although poured directly on the ground, is supported on concrete beams spanning between the column footings. The boiler house floors and the turbine house ground floor were given a troweled cement finish with a metallic hardener. The turbine room operating floor has a quarry tile finish, while a terrazzo surface is used on the switch house and toilet room floors. Operating platforms and walkways are 1½-in. steel grating.

Main framing runs lengthwise of the building. In addition to columns in the north and south walls, there are transverse lines separating the firing aisle from the rest of the boiler house, the boiler house from the turbine house and the turbine house from the switch house. Beam roof framing is used over the relatively short (about 19-ft.) spans of the firing aisle and switch house, but over the 47½-ft. span of the boiler house and the 50-ft. span of the turbine house trusses are required.

The entire outside of the building is faced with iron-spot matt-texture buff face brick, with darker brick spandrels below the windows. The interior is faced with unglazed vitreous ironspot facing tile in blended shades varying from buff to red. Tile units are 8x12 in. on the face. Similar tile is used in the partition walls between the three units of the building and is furred out to inclose the columns in these walls. Exterior trim, copings, window jambs and heads are cream Mankato stone. The exterior walls in general are 25 in. thick, providing deep window reveals.

The windows, of projected type, are made of heavy steel casement sections set in metal frames with tubular steel mullions between the sash units. An aluminum flush-type door is used for the main entrance while other exterior doors are of hollow metal construction. All exterior sheet metal work is copper.

The roof is of precast cement tile covered with 1-in. rigid cork board topped with 20-yr. 4-ply tarred felt surfaced with pitch and slag.

### Personnel

Hamilton & Weeber, Grand Rapids, Mich., are consulting engineers and Giffels & Vallet, Inc., Detroit, associate engineers. The Lake States Engineering Co., Chicago, Ill., held the foundation contract, including the wharf structure, while the Strom Construction Co., Grand Rapids, Mich., had the general contract.

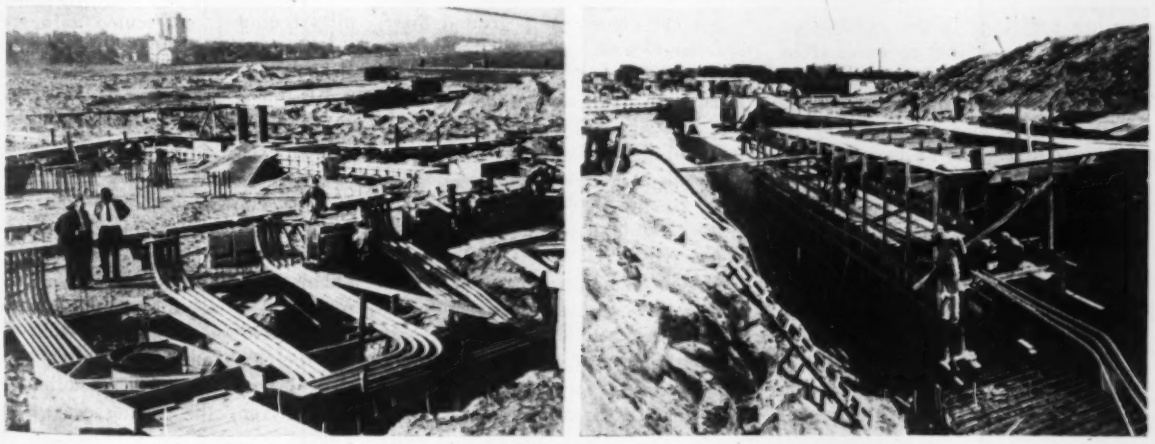


Fig. 4. **Construction views of Holland power plant: Left, placing electrical conduits that lead out of the switch house. Right, building the water tunnel between the power house and the intake.**

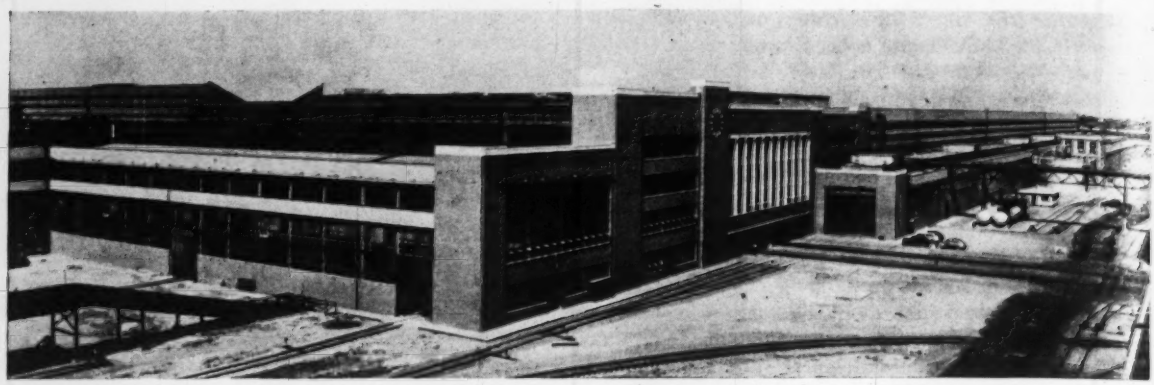


FIG. I. SOUTH END OF PRESS SHOP LOOKING ALONG ITS ONE-THIRD-MILE EAST FACADE.

# Automobile Press Shop at Detroit

ALBERT KAHN
Albert Kahn, Inc., Detroit, Mich.

***Contents in Brief—One of largest industrial buildings ever built, 1,600,000 sq.ft. of floor area, and the first two-story press shop in the automobile industry has been put in service at the Rouge Plant of the Ford Motor Co. Some 160 miles of steel H-piling support foundations, which include over 5 acres of a 3-ft. thick concrete mat. Crane bays are 90 and 100 ft. Framing in press floor removable and interchangeable to permit shifting presses. Conduits, buried in floor fill, head up at cabinets around crane columns which also enclose ventilation ducts and service piping.***

NEW AND UNUSUAL FEATURES of space planning, foundation design, heating and ventilating layout and power distribution are incorporated in the new press shop of the Ford Motor Co. at Detroit, Mich., which, in addition, is one of the largest industrial buildings ever built. L-shaped in plan, to fit in between existing buildings in the continuous production layout that exetends from ore docks to finished product at the Rouge Plant, the building extends 1,660 ft. along one leg and 934 ft. along the other. On its two floors it provides 1,600,000 sq.ft. of working space, and the 47,000 tons of piles, plates and shapes required constituted the largest steel order ever given on a single building.

One-story buildings are the rule for this type of structure, with the bases of the presses set in pits below ground level. Marshy soil conditions and a new type of production equipment layout dictated the design of a building with a second story to be used as the press working floor, the ground floor accommodating the foundations for the heavier presses and space for die storage, conveyors and auxiliary manufacturing operations. The production layout also dictated a clear second floor, with widely spaced columns supporting crane girders and roof. To adhere to this requirement, all toilet, coat and shower rooms are placed on a ground floor mezzanine, with the space below devoted to lunch rooms. Machine rooms, transformers and substations are likewise located on the ground floor. Of the total ground area, 17,300 sq.ft. is allotted to substations, 35,000 sq.ft. to lunch rooms and 38,000 sq.ft. to toilet, wash, shower and locker rooms.

The inclosing walls are of brick, gunite and steel sash except for a length of about 300 ft. on the east and west sides at the south end, where an architectural facade utilizing brick, stone and sash emphasizes the entrance to a wide roadway that runs through the building. The roof construction is cement tile with 1-in. cork insulation plus five-ply roofing. All sheet-metal surfaces are copper.

## Foundations

Throughout the area of the press shop the soil consists of a fairly stiff yellow clay, from 5 to 11 ft. deep, under which a blue clay varying from soft to very soft extends to a depth of 70 to 90 ft. Below this stratum of blue clay is hardpan in varying stages of compactness and of widely varying thickness resting on a limestone bed below. In view of the heavy loads involved, the choice of foundation was narrowed to types that provided bearing on hardpan or rock. Steel H-piles were used throughout for supporting the building and the machinery foundations, and the 8,600 steel piles required represented an aggregate length of about 160 miles and a steel tonnage of 22,000.

All piles, with the exception of about 400 which were required inside an existing building, were driven in single lengths varying from 80 to 105 ft. To accommodate such long piles in the available leads the contractor had to set the piles in holes about 20 ft. deep. These holes were provided by driving a hollow open-end shell about 26 ft. long, and forcing the earth out at the bottom with the piledriver plunger. After the pile was driven, the casing was withdrawn.

A number of piles were located adjacent to existing buildings which

were supported on wood composite piles. Also there were a number of existing services such as tunnels, sewers, etc., adjacent to which piles needed to be driven. In order that the piledriving would not cause upheaval of the earth, which might damage these facilities, all piles in such locations were pre-excavated to a depth of 30 ft. below the cutoff. This pre-excavation was done by driving a hollow shell into the earth to the depth of the pre-excavation and withdrawing the shell with the core of earth inside.

These methods of placing the piles necessitated the use of proper backfill material to eliminate settlement of the ground surface that would result from the flow of soft clay into the openings. Each individual pile, therefore, was backfilled with construction sand, a total of 9,400 cu.yd. of such material being required.

A normal type of concrete footing foundation was used for the crane and other columns. About a third of the ground floor area, however, is covered with a solid concrete mat 3 ft. thick. Such a foundation was chosen because, being designed to carry heavy presses set anywhere on the mat, it provided for the maximum of flexibility in arranging production facilities. Such a mat also provides maximum rigidity for the cast steel bases of the presses that extend from the top of the mat to the working floor above. Finally, the heavy mats aid in dissipating the vibration due to the operation of the presses.

## Superstructure

The main aisles of the press floor vary from 90 to 100 ft. in width, with longitudinal column spacing of 60 ft. Below the press floor the column spacing is in general 30x30 ft., except in the area where mat foundations occur, where the spacing is about 30x20 ft. to accommodate the particular size of presses used.

Except for the area directly over the mat foundations, the press floor is framed with girders at 30-ft. centers and beams at 7½ ft., to support an 8½-in. concrete slab haunched to the bottom of the beams. This slab is reinforced to provide for concentrated press loads up to 50 tons. Over the top of the concrete slab is provided a 2½-in. weak concrete fill in which such service lines as water, air and electrical conduits are embedded. Wood block finish is provided over the concrete fill. The flexibility provided by the weak concrete fill, which permits changes in service lines without damage to the structural slab, is an important element of the design.

In the areas where the heavy presses are used, press working floor framing is made of removable, interchangeable beams and steel plates to permit shifting a press from one location to another as production dictates. Should it become necessary to move a press, the bolted plates and beams in the new location can be interchanged with the existing framing around the press without waste and without refabrication. In the areas where such construction is used, the wood block flooring is placed directly on the steel plate.

The maximum use of natural daylighting in the building was a subject of considerable study, and an east-west monitor system was provided in which judicious distribution of sash and proper spacing of monitors combine to produce a diffused and practically shadowless daylight on the press floor, which permits of normal operations without artificial light.

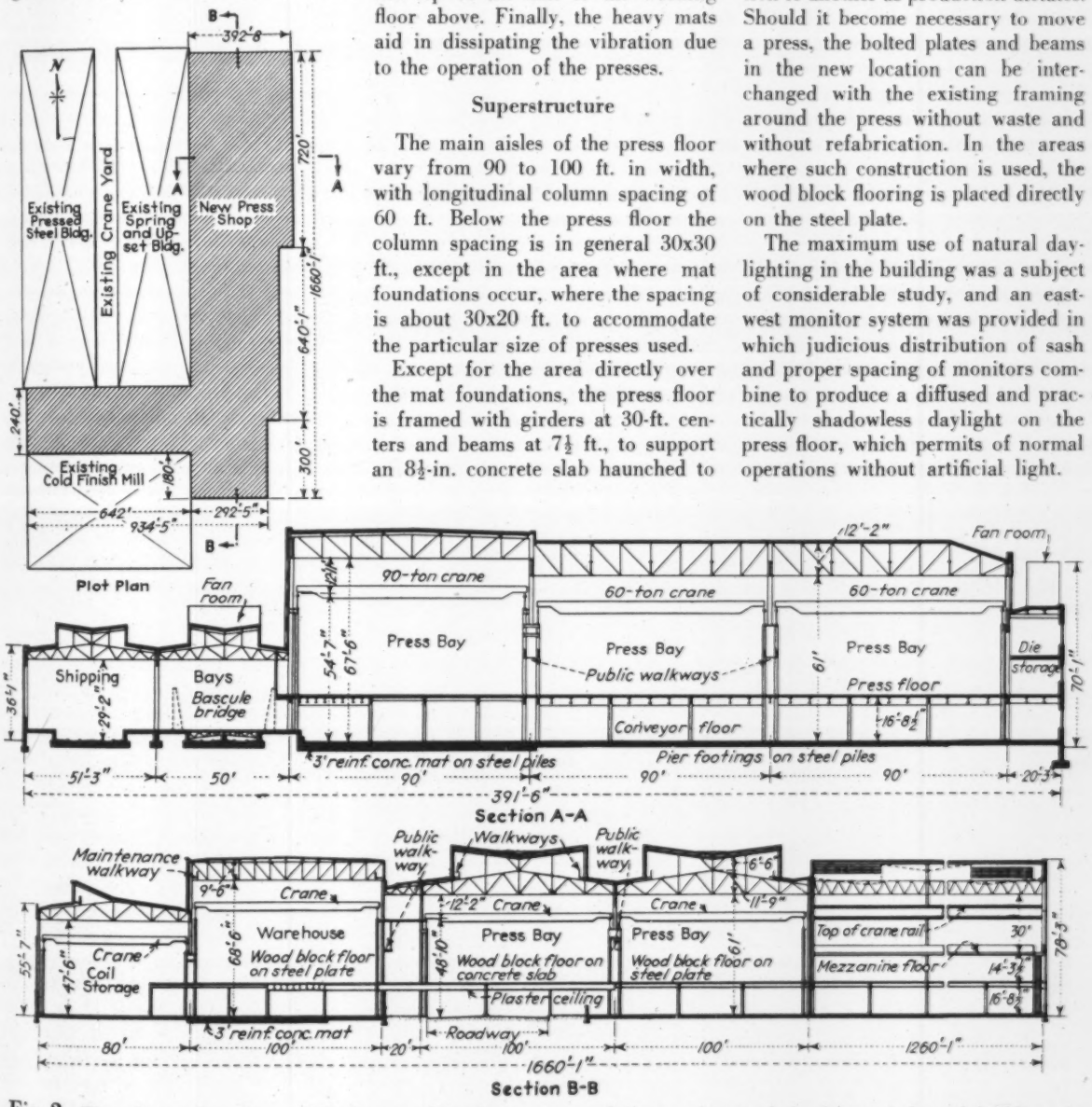



Fig. 2. **Plot plan and sections of Ford press shop depict structural layout of one of the largest industrial buildings in the world. A press operating floor raised above general ground level is an innovation in the automobile industry.**

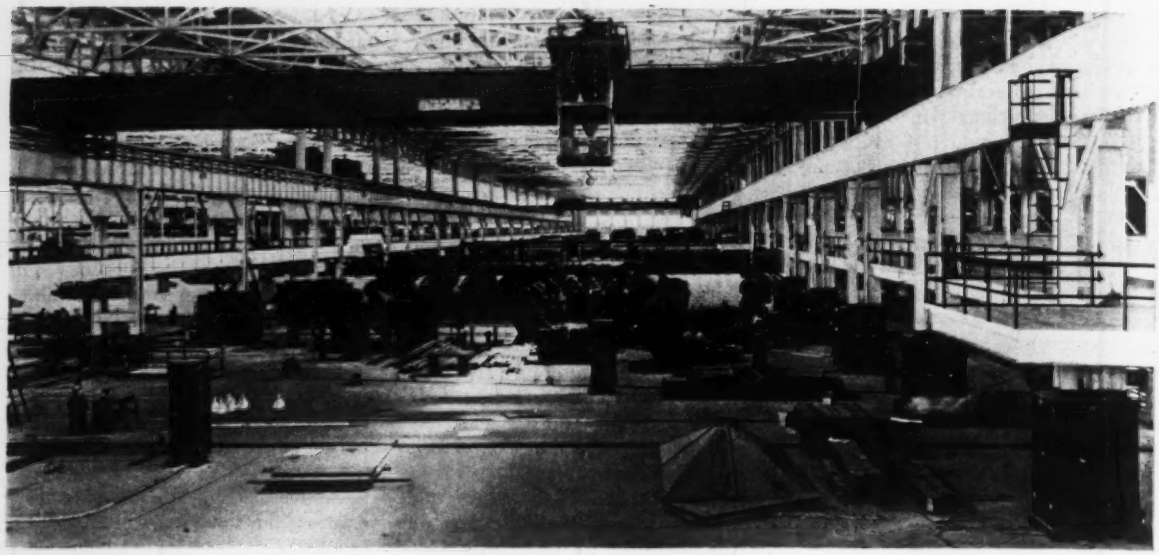


**Fig. 3.** General view of one of the press floor aisles during period when equipment was being installed. Note power panel cabinets at each column and absence of conduits, which are buried in floor.

The temperature and air requirements for the different departments into which the building is divided vary widely. To provide for these varying conditions, 20 supply units are installed having a combined capacity of 900,000 cu.ft. of air per min. The supply units are located in fan houses on the roof or in the truss space below the roof and are equipped with modulated-control intake dampers, air filters, heating coils and a fan driven by a multi-speed motor. Provision has been made for installing cooling coils for complete air cooling in the future, if desired.

### Heating and ventilating

The air from each supply unit is discharged through a duct system, which terminates on the ground floor ceiling. This ground floor therefore is used as a large plenum chamber. The method of ventilating and heating the second floor was ideally answered when the owner decided to eliminate all unsightly electrical switchboard panels and house them in specially designed cabinets or cubicles at each double crane column. The space between these columns which is enclosed by these cubicles is 60x30 in. in plan and by leaving out the second floor construction at these points ducts could be run up through these openings and all air from the ground floor plenum exhausted into the second story, passing through to unit heaters at the top of the ducts 10 ft. above the second floor. Roof drains and other piping are also concentrated in these openings between the crane columns.

The temperature of the air supplied by the roof supply units is that required to satisfy the first floor only, namely, 60 to 65 degrees. Heat loss here is small but on the second floor, where large glass areas are used, an air delivery temperature of 95 to 100 deg. is required. This heat is added by the unit heaters on the duct lines. This arrangement not only makes possible the removal of the air supply from the first floor but it permits utilization of the heat gain from that floor. The unit heaters can also operate independently, the air from the second floor being recirculated when no air removal is required from the first floor. Also, any part or all of the air can be recirculated through the main supply units.

All of the utility rooms on the first floor such as toilets, shower rooms, lunch rooms, etc., are of necessity mechanically ventilated and heated. Additional supply units serve these rooms exclusively.

### Electrical facilities

Electrical service for a building of this size presents similar problems to those encountered in supplying a normal city of 125,000 population, as is evident from the fact that eleven electrical substations are required at strategic points throughout the building, and that there are 6,787 lighting fixtures, 750,000 ft. of various sizes of conduit, 470 miles of various sizes of cable and wire, and 376 electrical cubicles or housings to mount around the columns and hold the power and lighting panels.

It was required to provide service for 3,400 motors, 440-volt, 3-phase, 60-cycle, totaling 38,000 hp.; 40,000 kva of 460-volt, 3-phase, 60-cycle welders, and 5,500 kva of 240-volt welders and 240-volt power for miscellaneous portable equipment such as hoists, drills, etc., which were too large to be fed from the 110-volt single-phase service. The connected lighting load is 3,860 kw., and 6,000 kva of transformer capacity has been installed to carry it. The lighting requirements were to provide an average of 22 to 25 foot-candles on the press floor working plane.

The system of power distribution is unique. The company requires each motor to have a separate fuse and circuit on a power panel so that trouble in any one machine will not affect other machines. It was necessary to provide 3,200 circuits for motors alone on the press floor, plus additional circuits for the welders. To house all of the necessary panels special cubicles were designed, as previously noted, to fit around all of the columns. The cubicles for the interior columns are 8 ft. 7 in. long, 5 ft. wide and 8 ft. 9½ in. high and contain space for four panels on each side and two panels on each end. In general, the ends are used for lighting, high-cycle and d.c. power and

the sides for power and welding, panels being installed in proportion to the machine requirements in the vicinity of each particular column. Outside columns and specially shaped columns required a different design of cubicle, but in general the requirements were the same.

Ventilator ducts, roof conductors, steam pipes and accessory services come up through the center of the cubicle. This combination of electrical panels, ventilation ducts and accessory services should prove very satisfactory as there is a minimum of interference between component parts, and the location of the panels around the columns makes for efficient operation and servicing and does not use up nearly as much expensive production floor area as would be expected.

Ground floor cubicles are similar to those on the press floor except that they have spaces on each side for two master panels and one sub-distribution panel and space on each end for one panel. The ground floor required only a few machine circuits compared with the press floor.

Each feeder breaker in the secondary switchgear, which is located in the substations on the ground floor, has three 4-in. conduits leaving at the bottom and running through the concrete to nearby columns where they come up under the master panel position in the ground floor cubicles. See Fig. 4. Feeder conduits are carried from the cubicles to the machines in the fill on the concrete floor or in a slot between the wood blocks on the steel plate floor, the remaining space being filled with mastic. Larger conduits, which could not run in the wood block, are dropped down through the floor, carried along the ceiling of the ground floor and brought up through the press floor to the starter. These methods get all feeder conduits out of the way.

The building was designed by Albert Kahn, Inc., engineers and architects, Detroit, Mich.

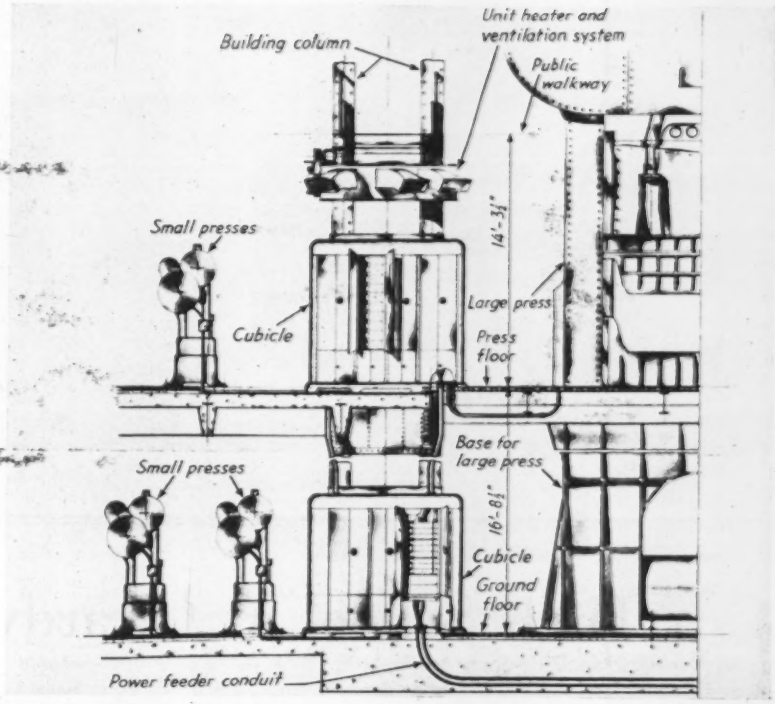



**Fig. 4.** Details of power panel cabinets and ventilation ducts at crane columns.

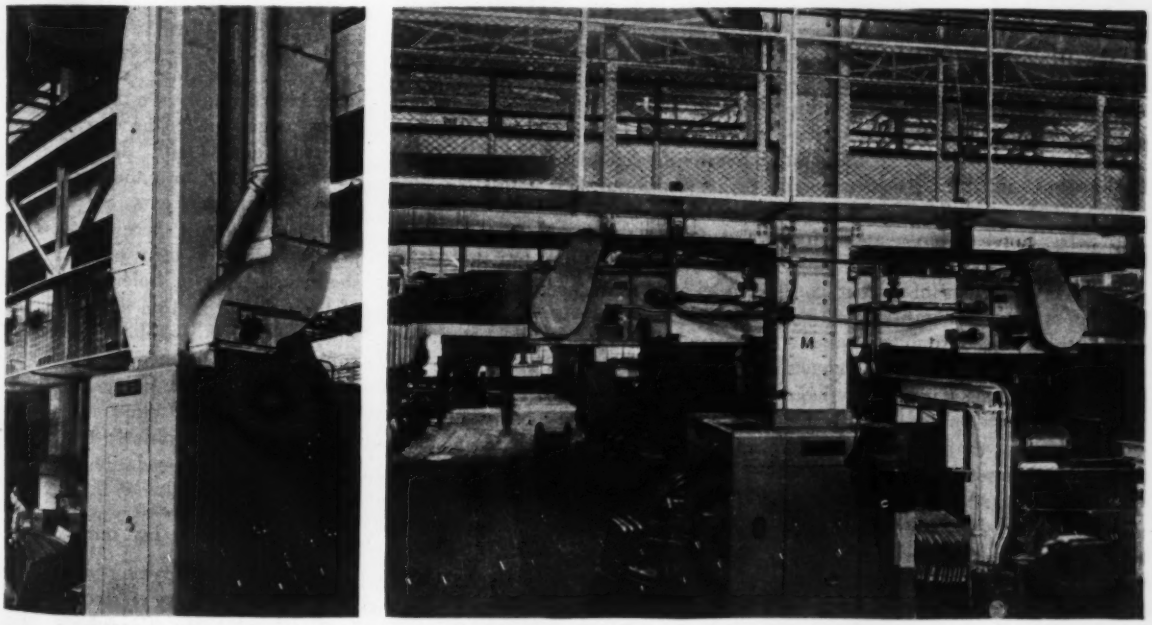


**Fig. 5.** Ventilating ducts and service piping are concentrated at crane columns and enclosed in the power panel cabinets. In right view, a unit heater is attached to one of the ducts above a power panel cabinet.

FIG. 1. WALLS OF PORCELAIN ENAMEL STEEL DISTINGUISH HIGH SCHOOL BUILDING AT GIRARDVILLE, PA.

# High School at Girardville, Pa.

***Contents in Brief—Builders of Girardville's new high school overcame a perplexing subsidence problem, created by mine workings in the area, by putting up a light all-steel building whose outstanding feature is a wall of enameled steel sheets. Heavy, rigid buildings cracked and light-frame buildings were non-fireproof. The new building is planned to overcome these objections.***

IN THE ANTHRACITE COAL mining district of northeastern Pennsylvania, school districts and designers of school buildings have had a perplexing problem on their hands for a good many years. Unpredictable subsidence of the earth's surface, due to the honeycombing of mine workings underneath the sites and on neighboring hillsides, has ruined many schools of inflexible masonry fireproof construction and has forced school boards to place their children in buildings of timber construction which, although more flexible and therefore more durable under settlement, are subject to fire danger.

Girardville, a coal mining village of less than 5,000 population, is the home of one of the most glaring examples of these subsidence-ruined school buildings. Needing a new high school building, the Girardville school board sought designers who would go beyond the practice of conventional construction to produce a building that would combine the fireproof qualities of brick and concrete construction with the light weight and flexibility of a timber frame.

Three men in Pottsville, Victor Muncy, a consulting engineer, and D. H. Grootenboer and P. G. Knobloch, associated architects were chosen. The physical result of the cooperation of these three men with the Girardville school officials is a steel frame building with attractive blue and white enamel steel exterior walls. The steel frame gives a reasonable amount of flexibility, and the porcelain enamel steel sheet walls eliminate the weight of masonry—about 3,000 lb. per lineal foot of foundation wall on this job, according to the designers. The enamel sheet has other advantages. Ordinary blows received in transit do not injure the surface, and to date only two young Girardville citizens have managed to throw stones with sufficient force to chip the surface. An important consideration in this coal mining area is cleanliness, and the enamel steel sheets have proved to be practically self-cleaning under the action of rain.

Porcelain enamel steel sheets for structural work are a recent development. They have been used as ornamental covering for walls before (*ENR*, Dec. 9, 1937, p. 929), but this is believed to be the first case in which the entire exterior of a building has used this material as its only protection from the elements. The sheets used are 18-gage rectangular units averaging about 4 ft. x 2 ft. with 1-in. flanges on all sides (Fig. 3). The long dimension is placed horizontally. On the upper and lower edges near the corners are located "ears" with drilled holes. Lower ears key into the next lower sheet and upper ears are screwed with self-tapping screws to steel plates which in turn connect with steel studs. A $\frac{5}{16}$-in. hole in the center of the top and bottom flange of each sheet provides a bolted sheet-sheet connection. Each sheet is lined with $\frac{1}{2}$-in. of rigid insulating board to eliminate a tinny sound when it is struck by a hard object; this board also adds to the insulation value of the completed wall.

## Building lay out

Two elements, a gymnasium-auditorium and a two-story classroom building make up the Girardville high school. The gymnasium is 123x62 ft.,

and the main building is 142x60 ft. A basement under the auditorium is used for manual training shops, while the space under the back half of the main building accommodates locker rooms and the boiler room. A corridor runs the length of the main building at all three levels. On the first floor are five classrooms, two toilet rooms and the administrative offices. Nine rooms for various purposes are located on the second floor.

Outside foundation footings are spaced at intervals varying from about 8 to 30 ft. with 11½ ft. predominating for the main building and about 20 ft. for the gymnasium. Interior column footings create bays roughly 20x20 ft. in the gymnasium and 15x24 and 15x13 in the main building. Reinforced concrete columns and walls extend from the footings to the first floor.

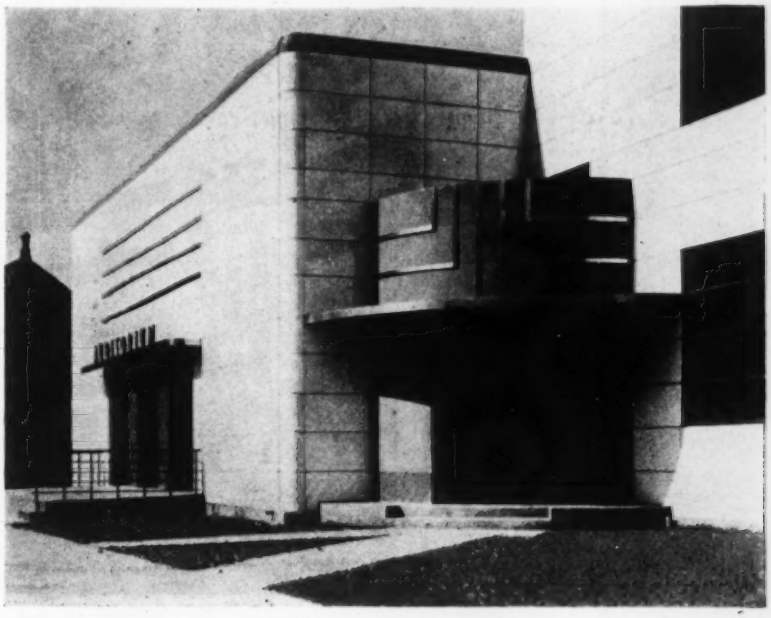


Fig. 2. Enamel steel exterior walls permit unusual facade treatment at doorways. Colors are blue and white and trim is stainless steel.

### Steel frame

Conventional steel framework with bolted connections is used in the building. Open truss steel joists are framed from front to back of the building, and most of them are spaced 18 to 20 in. Depths are 10 and 12 in. Where joists bear on steel they are welded 1 in. each side of bearing. In the gymnasium the same type joists, spaced 16 and 17 in., support a wood floor. Main building floors are 2½-in. concrete laid directly on metal lath which is stretched over the tops of joists. Floor slab temperature reinforcement is 6x6 10/10 mesh. Design live loads are as follows: roof, 40 lb. per sq. ft.; classroom, 60 lb. per sq. ft.; corridor, 80 lb. per sq. ft.; gymnasium, 125 lb. per sq. ft.

Open truss roof joists for the main building are spaced at 4 ft. Roof trusses over the gymnasium section are 60-ft. spans, 2 ft. 4 in. deep at the walls and 2 ft. 8 in. deep at the center. Spacing varies from 5 to 6 ft. This steelwork is painted a light blue to give the inside of the roof an attractive appearance. All roof supporting members are covered by a flat surface made up of 20-gage channels, 1¼ in. deep and 6 in. wide, connected by a spot weld at every purlin. Units span at least three purlin spaces. One-half inch of asphalt mastic is mopped on the steel deck and this is topped with a slag fill. The parapet backing is also of this steel channel construction.

Wall supports throughout the building are steel channel studs, spaced on an average of 4 ft. Six-inch studs are used in the gymnasium and 4-in. studs elsewhere. Gymnasium studs are strutted with tie rods. After erection of steel, connecting plates for the porcelain enamel exterior were bolted to the studs and columns and were field-drilled for mounting the porcelain enamel sheets. Plate-sheet connections are made by tapered steel screws. Joints between the sheets are caulked fully with "alumastic," a permanently pliable compound. Blue and white, the school colors, are used to give the exterior striking appearance.

After metal-lath-backed plastering was completed, a mineral wool insulation material was blown in between the studs under about 3-lb. pressure. Plaster ceilings are hung below the open truss joints. Interior walls are made up of the 4-in. channel studs plastered directly over metal lath.

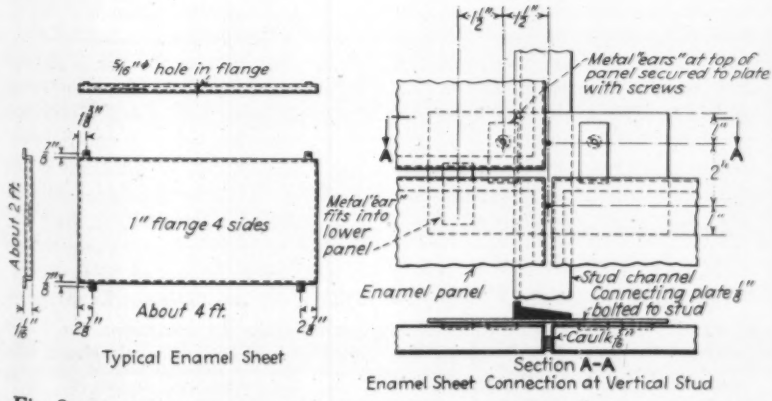



Fig. 3. Details of porcelain enamel steel sheet panels and their connections to steel columns and studs.

### Acknowledgment

In addition to the three men already mentioned, the following were responsible for construction: H. A. Williams of Allentown, Pa., was general contractor at $121,196; Truscon Steel Co., Cleveland, Ohio, furnished the structural, reinforcing and special steel, totaling about 250 tons; The Enamel Products Co. of Cleveland furnished about 23½ tons of porcelain enamel panels. Frantz-Bockey of Cleveland erected all steel and placed the enamel sheets, sash and roof deck.

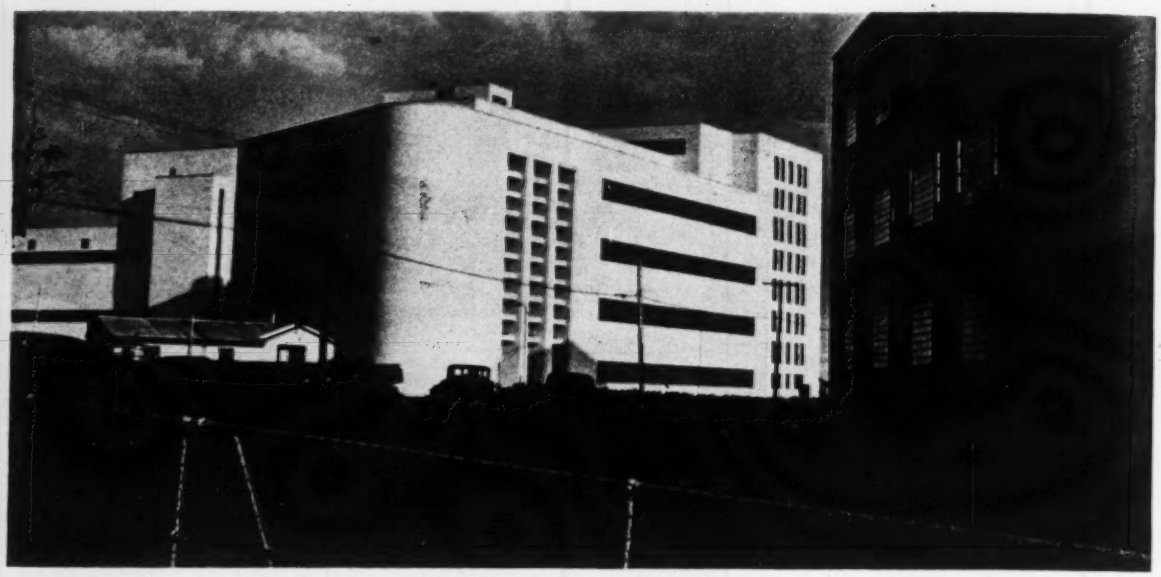


FIG. 1. FORM AND FACADE SUGGEST THE MODERNISM AND CLEANLINESS BUILT INTO THIS NEW FOOD PLANT.

# Baking Soda Plant in Syracuse

***Contents in Brief**—Solid walls of brick relieved by glass block panels of various sizes, a stepped roof outline and an L-shaped plan impart a striking appearance to the new multi-story bicarbonate of soda plant for Church & Dwight Co., Inc. All-welded frame carries heavy storage bin loads, some connections being designed for 250,000 lb. Air conditioning varies from simple ventilation to complete filtering and dehumidification, the latter accomplished by a combination of refrigerant and cool lake water.*

FROM A MULTI-STORY FACTORY of striking appearance, whose advanced architecture is matched by such modern technical features as an arc-welded frame and air-conditioning, Church & Dwight Co., Inc., producers of familiar Cow Brand and Arm & Hammer Brand bicarbonate of soda, will soon be turning out large quantities of these products by a new and improved process. This unusual building, designed and built by The Austin Co., Cleveland, affords an excellent example of the application of modern architectural, structural and mechanical knowledge to the problem of improving our industrial plants.

Although the building is built around a special manufacturing process and planned at every step to house specific items of equipment, these facts need be considered in only the most general terms in an article such as this, which is focused on the problems that the designers and builders had to solve in providing an inclosing and supporting structure. Thus it is only necessary to know that the raw product is received in pipes as a sludge or slurry from a nearby manufacturing plant, and that after passing through numerous processing operations it is discharged, again by a pipeline, as the dry powder of commerce, which is automatically conveyed underground to a packaging plant across the street.

## General layout

The building, principal item in a $2,500,000 development program, is L-shaped in plan, 220 ft. along the base, which fronts on the street, and 265 ft. along the leg. The base is 80 ft. wide and the leg 72 ft. In the front section of the building there are four fairly well defined floor levels, but in the leg the floors are varied to suit the equipment. Roof levels are at various heights (minimum 62 and maximum 80 ft.) to accommodate the equipment, and are principally affected by three sets of storage tanks. In fact, these tanks or bins, and other special equipment, including three sets of stairs that are placed in inclosures projecting from the building walls, largely fix both the mass effects and the facade treatment—a combination of brick, glass block and limestone and stainless steel—which distinguish the building.

The leg portion of the L-shaped building in which the manufacturing operations begin is divided into two sections designated as A and B, while the base of the L, or the front of the building, is C. In this latter part of the building is located the main entrance and the plant offices, which occupy the front part of the first floor. Offices are set off from the manufacturing space by partitions, the lower half of which is tan salt glazed tile, while the upper half, to the ceiling, is glass block; a limestone sill separates tile and glass block. Acoustical plaster

ceilings and quarry tile floors are a feature of the offices. There is a basement under section C, but the first floor of sections A and B is laid directly on the ground.

### An all-welded frame

Buildings built to house special processes are usually characterized by a variety of unusual structural details. This baking soda building is no exception. In addition, it commands interest because of its all-welded frame, which required some 1,600 tons of steel, almost entirely of rolled sections and including some girders of the maximum size and weight available. Foundations consist of simple spread footings on dense clay at shallow depths. Concrete floors are used in parts of the four-story section C and consist of a 4-in. structural slab plus a 1-in. wearing surface. The first two floors are designed for a 350-lb. per sq.ft. live load, while a 125-lb. load is used for the upper floors. In sections A and B, the floors consist of open-grid steel panels or of checkered steel plate.

Unusual details in the welded steel frame arise from two principal conditions—the necessity to support the 250-ton concrete bins in section C and the requirement that the frame resist the unusually high wind load of 25 lb. per sq.ft. Meeting the wind load requirement at most of the beam-to-column connections was made more difficult by the requirement that no part of the connection extend above the top of the beam to complicate the installation of steel checkered plate floors which had to fit snugly against the columns. This being a food factory, absolutely tight floors were specified in the interest of cleanliness.

Accordingly, the connections that transmit wind moments, which are usually fastened to the top flange of the beams, are in this case placed on the web just below the top flange. They consist of T's made of split I-sections whose flanges are field-welded to the columns while the stem is shop-welded to the beam. Seat connections, which carry beam vertical loads into the columns, are also cut from I-sections. They are shop welded to the columns and field welded to the beams. See Fig. 3.

### Heavy girders support bins

Bin support framing is the heaviest in the building and consists of rolled girders arranged in square panels and connected to the columns by heavy angles. These girders are 36-in., 300-lb. sections and are reinforced over the center half of their lengths with ¾-in. cover plates top and bottom. Across the corners of each square panel, a 30-in., 124-lb. girder is welded, making the panel octagonal to provide eight points of support for the bin.

Where this bin framing connects to the flanges of the columns the load is divided between a seat angle and two web angles. Where the framing is to the column web, precluding the use of a seat angle, the web angles are lengthened to carry the entire load. The 45-deg. connection of the corner girders to the main girders is through 8½-in. stiffeners welded between the flanges of the main girders. Details are shown in Fig. 3.

A special detail occurs at the west end of the framing supporting the finished product bins, where one of the girders is carried out to a connection with a line of main building girders. This is joint A in Fig. 3. As shown in Figs. 3 and 4, the bin girder intersects this building girder at a 60-deg. angle and its top flange is at the same elevation as the bottom flange of the building girder. The connection is made by an 8¾-in. hanger plate 6 ft. long, welded to the web of the building girder over its top half and (through ¾-in. connection plates) to the web of the bin girder over its lower half. The welds are ½ in. in size and the total load transferred at the connection is 205,000 lb. It will be noted that a bracket cut from a 36-in. girder is used under the building girder, but this is used largely to give a finished appearance to the detail and carries very little load. The heaviest loaded column in the building is under a group of six bins in the northeast corner. It is a 14-in., 342-lb. section and carries a load of 1,489,000 lb.

The bins themselves are also interesting structurally. Of reinforced concrete, with 6-in.-thick walls, they are

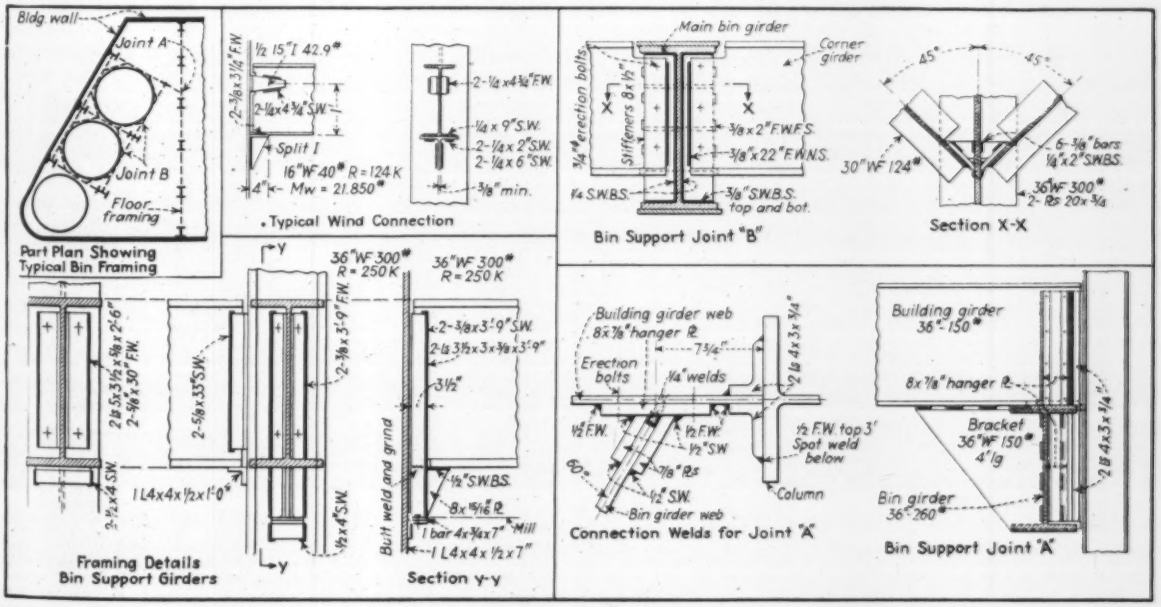



Fig. 3. Structural details of the arc-welded frame, particularly the connections in the supports for the heavy storage bins.

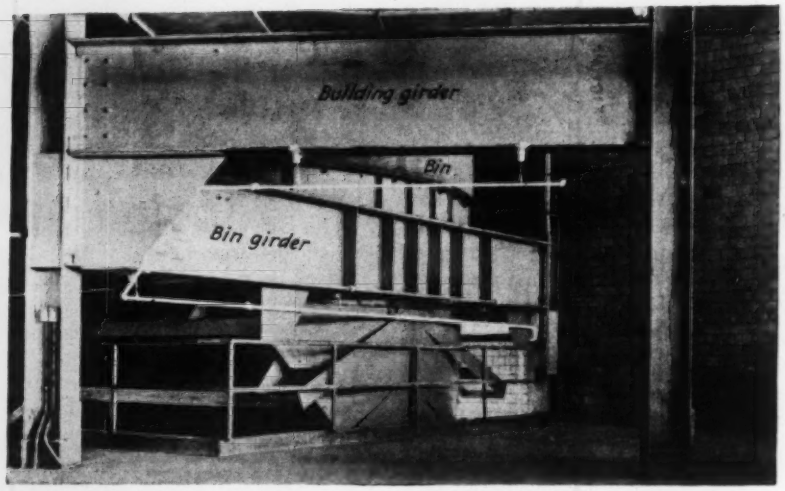



**Fig. 4.** Special bin framing, designated as joint A in Fig. 3. The erection bolts in the web of the building girder show the location of the welded hanger plate on the opposite side which carries a 205,000-lb. reaction from the bin girder.

20 ft. in diameter, and about 24 ft. high. They are lined with stainless clad steel, the sheets being welded to structural steel T's embedded vertically in the concrete on about 3-ft. centers with their heads flush with the inside face of the concrete. Bar lugs welded crosswise of the stem of the T's at intervals aid in anchoring the T's in the concrete. During construction of the bins, the vertical T's were utilized as supports and guides for the sliding forms, clips nailed to the forms fitting over the heads of the T's.

The bin walls rest on a 6¼-in. plate fastened with welded angles to the vertical T's. This plate in turn rests on an 18-in. steel ring channel set vertically and flush with the inside face of the bin and resting on a ¾-in. plate which is welded to the supporting girder framing. At points of bin support on this girder framing, both the channel ring and the girder are strengthened by groups of stiffeners inserted between the flanges.

### Function fixes form

The processes and equipment housed in the building exert a major effect on its shape and its inclosure elements—walls, roof and windows. The presence of the bins, for example, dictated solid walls on the south and north faces of section C and a curved corner at the southeast. Tall equipment in sections B and C raised the roofs in these areas above the level of the other parts of the building. The necessity for roof-level conveyors accounts for one of the penthouses. And so on. But even with these heights and treatments fixed, much architectural judgment was required to produce the well proportioned masses and the integration of masonry and glass that characterizes each of the facades.

### Extensive use of glass block

Horizontal bands of glass block constitute the majority of the windows. In section C these bands correspond to floor levels, but in sections A and B, where floor levels vary, the glass bands are located to give the best appearance from the outside, commensurate with good interior lighting. Exceptions to the horizontal glass block bands occur in the stairwells, where continuous vertical runs of glass block are used, and in the north end of the street facade, where some 35 panels of glass block, 40 in. wide and 6 ft. 9 in. high, resembling windows, are used to admit light around and beyond the concrete bins. This grouping of windows also serves to balance the monumental treatment adopted to emphasize the entrance at the opposite end of the building, and to relieve the otherwise large expanse of solid masonry wall.

All glass block is set in fibre glass expansion joints in structural steel frames covered on the outside with stainless steel trim. The horizontal bands are divided into 20-ft. lengths by stainless steel channel joints for expansion purposes. Walls are 8 or 12 in. thick. The exterior consists of 4-in. light buff smooth face brick. In the parts of the building where utmost cleanliness is essential these are backed by 8-in. salt glazed tile giving the 12-in. thickness. Elsewhere, the backing is a 4-in. sand lime brick, gray in color for light reflection. By laying up the exterior brick first, and applying ½ in. of cement parging before the inside brick or tile is added, a completely waterproof wall is said to be insured. Window sills and coping are limestone set on two-ply waterproofing fabric, with through flashing.

Roof construction consists of precast haydite tile on steel joists. Covering consists of a 20-yr. built-up tar and gravel roofing, but over sections B and C this is supplemented by 1-in. rock cork insulation board.

### Air conditioning layout

Treatment of the air supplied to this bicarbonate of soda manufacturing plant is varied according to specific requirements of the manufacturing process. Thus in the section A, where all of the product is inclosed in pipes, no treatment is necessary but, as the product is refined to a powder and the chances of contamination with germs or moisture increase, the degree of conditioning of the air is stepped up until, in section C, all modern controls are utilized.

Taking up the various zones of air treatment in order, section A is assured of fresh air by four intakes equipped with propeller-type fans. Heat in winter will be provided by conventional steam unit heaters. Adjacent, in section B, in addition to mechanical ventilation, air filters are installed. These are incorporated in eight large steam unit heaters equipped with blowers and connected to louvred openings in the walls. These machines take up much less space than would one large room and the necessary distributing ducts; being located at various levels above the floor, efficient distribution of air is assured. The various locations are also chosen to take care of heat from specific pieces of equipment.

The eight filters and ventilating units supply 70,200 cu.ft. of air per minute to section B of the building, and provide for a complete air change every 6 min. Also, the system is to be operated to keep this section of the building under pressure at all times; leakage will therefore be from inside out and never the reverse, which would permit unfiltered air to come in contact with the product. In both sections A and B, air is exhausted by heat valves in the roof.

In section C the product in powder form comes into contact with the air. Therefore, in addition to clean air, there must be exact humidity control, and a complete air-conditioning system is installed. Ducts are numerous and large to supply the 150,000 cu.ft. of air per minute that is required.

### Air conditioning equipment

There are two main air inlets, both on the west or back of section C. One inlet, on the first floor, serves an air conditioning room in the basement, which supplies the basement, first and second floors. The other inlet is located on the fourth floor and serves an air conditioning room on the fourth floor which supplies air to the third and fourth floors. All excess air is exhausted through back-draft louvres in the roof monitor of section C.

These air conditioning rooms are not "rooms" in a strict sense, but rather walled inclosures around the equipment. The walls are of galvanized sheet steel and are easily removable to facilitate repair of the equipment. Inside the rooms are the humidifier units, the filters and a majority of the controls. The basement Freon compressors and the fans are located outside the air-conditioning room, while those serving the fourth floor air conditioning room are in a separate room on the third floor. Fans and compressors in this air conditioning and ventilating system are driven by a total of 64 electric motors ranging in size from 50 hp down.

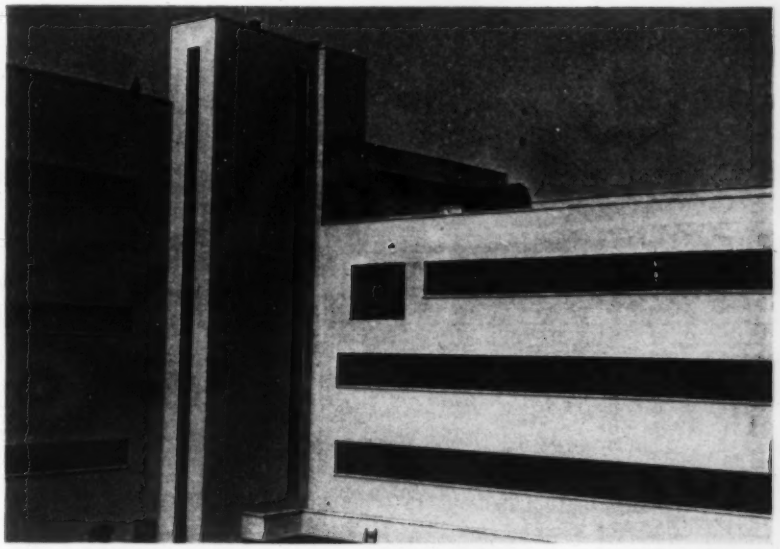


Fig. 2. Rear view of building showing one of the outside stair wells, and to its right the top floor air inlet into section C of the building. Some of the smaller air inlets into section B are at the lower left.

Two special features of the air conditioning system deserve mention. One is the use of water brought in a 16-in. pipeline from nearby Onondaga Lake and delivered in an 8-in. pipe to supplement the Freon refrigeration in the dehumidifiers. Separate coils for circulating the water and the Freon are used. Placed in the line of the incoming air these cooling coils lower the dewpoint of the air, causing rain or dehumidification. The lake water reaches a temperature of 50 deg. or less in winter, and it does not rise above 65 deg. until September. During April, May and June, therefore, it is planned to use water exclusively, while in the remainder of the year water and Freon will be used in combination. The system provides for lake water to be used at the rate of 600 gpm.

The second feature of the air conditioning system is the use of automatic humidity controls. Thus, if the outside air is of proper humidity and temperature it will be used exclusively and subjected only to a filtering process. If outside humidity is high, however, only a small amount of outside air will be used and it will be mixed with used air recirculated from the inside. The recirculated air intakes are equipped with filters identical with those used for the outside air. These filters are of the air-mat type, made of paper, a type chosen because of its low maintenance cost.

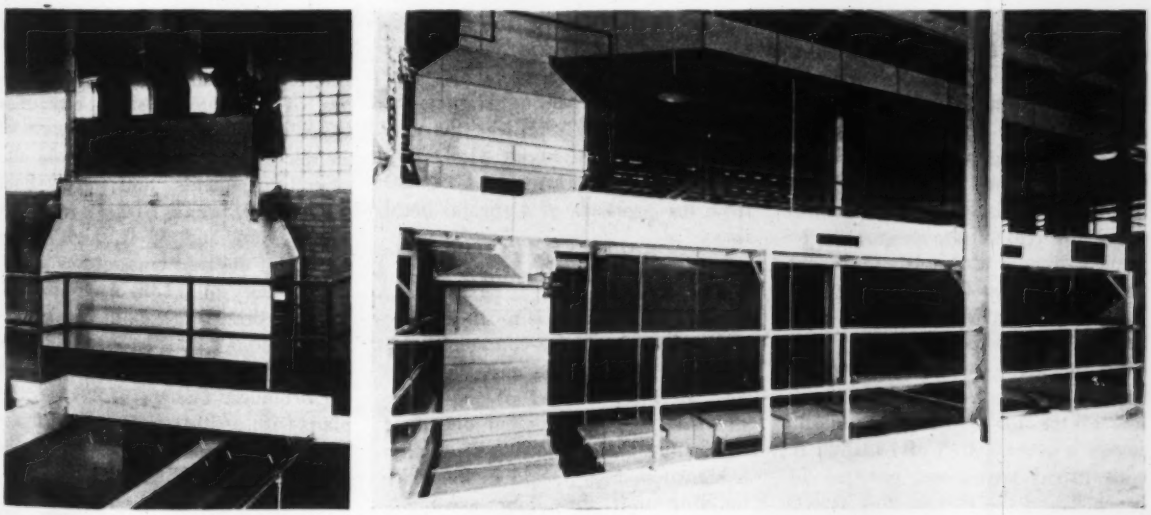


Fig. 5. Air conditioning equipment. Left, one of the filter and fan units in section B. Right, typical ducts for filtered, humidified air in section C.

FIG. 1. MODERN MUNICIPAL BUILDING CONTRASTS SHARPLY WITH ITS PREDECESSOR AT RIGHT.

# City Hall and Auditorium for Topeka

R. A. COOLIDGE
Griest & Coolidge, Architects, Topeka, Kans.

***Contents in Brief—By combining a 3-story city hall and a 4,247-seat auditorium in a single structure, a medium-sized city has greatly improved its municipal plant. The auditorium also includes a basement exhibition hall and meeting rooms for gatherings of 75 to 450 persons. Frame is reinforced concrete, exterior walls limestone, floors terrazzo and wood block. Roof trusses of 164-ft. span are isolated from rest of structure. Part of stage is on hydraulic elevator. Both city hall and auditorium are air conditioned. Cost, 30 cents per cu. ft.***

LIKE MANY CITIES of its size (70,000 population) Topeka, the capital city of Kansas, has had to house its municipal offices in a completely outmoded building and has lacked adequate facilities for meetings and conventions of its citizens and visitors. Both of these inadequacies are being removed at the present time through the construction of a new combination city hall and auditorium. Completion of this two-unit structure about the end of the year will give Topeka one of the outstanding municipal buildings in the country.

Located on a block-square plot of 320x450-ft. dimension, one block from the main business area and a similar distance from the hotel facilities of the town, the new building covers a ground area of 188x306 ft., with broad lawns and gardens between it and the surrounding streets. The city hall unit, three stories and basement, is 67x188 ft. while the auditorium unit, some 25 ft. higher, is 238 ft. long and 188 ft. wide. Structural framing is of reinforced concrete except the floor and roof in the auditorium, which is of structural steel. A steel roof deck is also used over the auditorium. The entire exterior of the building is surfaced with stone. A PWA project, the new building will cost about $1,500,000 of which the city furnished $850,000 from the proceeds of a special bond issue.

### City hall layout

The city hall unit is north and the auditorium south of a common dividing wall. Each of the units is therefore an integral part of the entire structure, yet there is but one door connecting them. The first floor plan is shown in Fig. 3, and in the office building unit this floor accommodates the finance and water departments. Beneath it, in the basement, are located the storage rooms, vaults, and the office of the election commissioner. The entire second floor is given over to the city clinic and will contain examination rooms, laboratories, dental and X-ray rooms, doctors' and nurses' offices, and public and private waiting rooms for patients. On the third floor will be the offices of the park department, street department, city engineer, the mayor and the city commission.

### Auditorium layout

The auditorium unit was designed as a general purpose structure, available for the use of the sundry activities of a moderate-sized city. The arena type was selected because of the necessity for a place to hold athletic tournaments and large floor shows. The arena, 102 ft. wide by 132 ft. long and 47 ft. high to the bottom of the roof trusses, has a seating capacity of 2,132. An 8-tier balcony on three sides of the area seats an additional 2,115, so that a total of 4,247 seats is available for a stage performance. The stage, 88x34 ft. in plan, with a 50-ft. proscenium opening, is located at one end of the U-shaped area. Directly in front of the stage is a hydraulic elevator with a 50x9½-ft. platform, which can be brought up to the stage level and

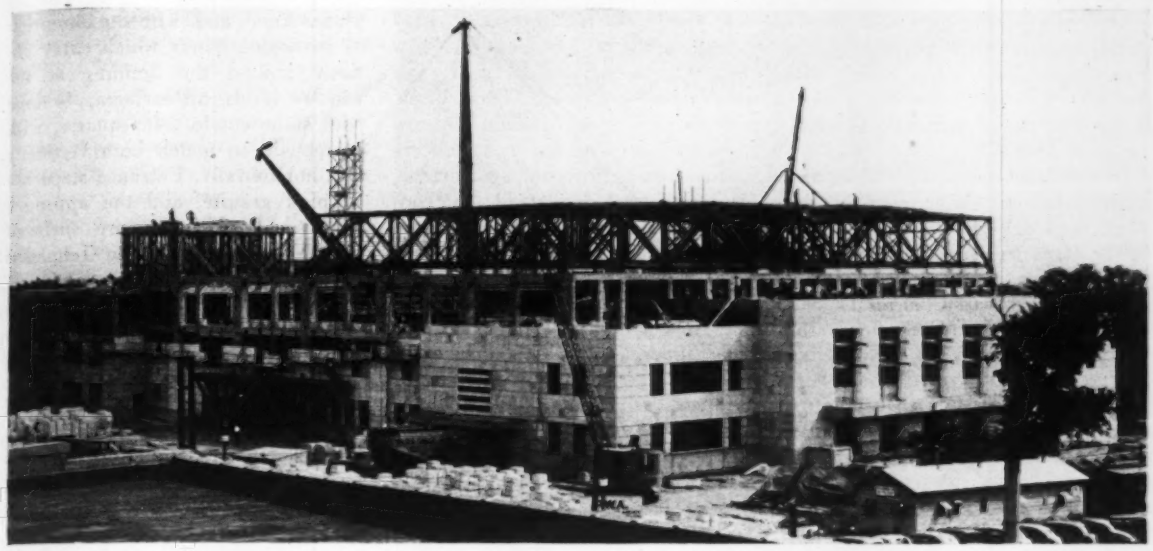


Fig. 2. Erecting 164-ft. span trusses over auditorium section of Topeka municipal building. City hall unit projects beyond auditorium at left.

used for a speaking platform, or as an enlargement of the stage; or it may be lowered to serve as an orchestra pit. An important use of the elevator will be to transport the removable arena seats from the first floor to the basement.

This basement floor under the arena is planned as an exhibition hall providing 19,000 sq.ft. of area. It will also serve as a banquet room in which 1,800 guests may be seated at one time. Cars or trucks may be brought into the exhibition room direct from the street by means of a ramp driveway. The basement floor also accommodates check rooms, first-aid rooms and the public toilets.

As will be noted from Fig. 3, the first floor of the auditorium also accommodates three committee rooms on each side of the main arena. Seating 75 persons each, the three rooms may be thrown together to accommodate an audience of 225. Behind the main arena on the first floor are the auditorium offices, the lobby and an additional room with a seating capacity of 125 persons. Directly above, at the balcony level, are two

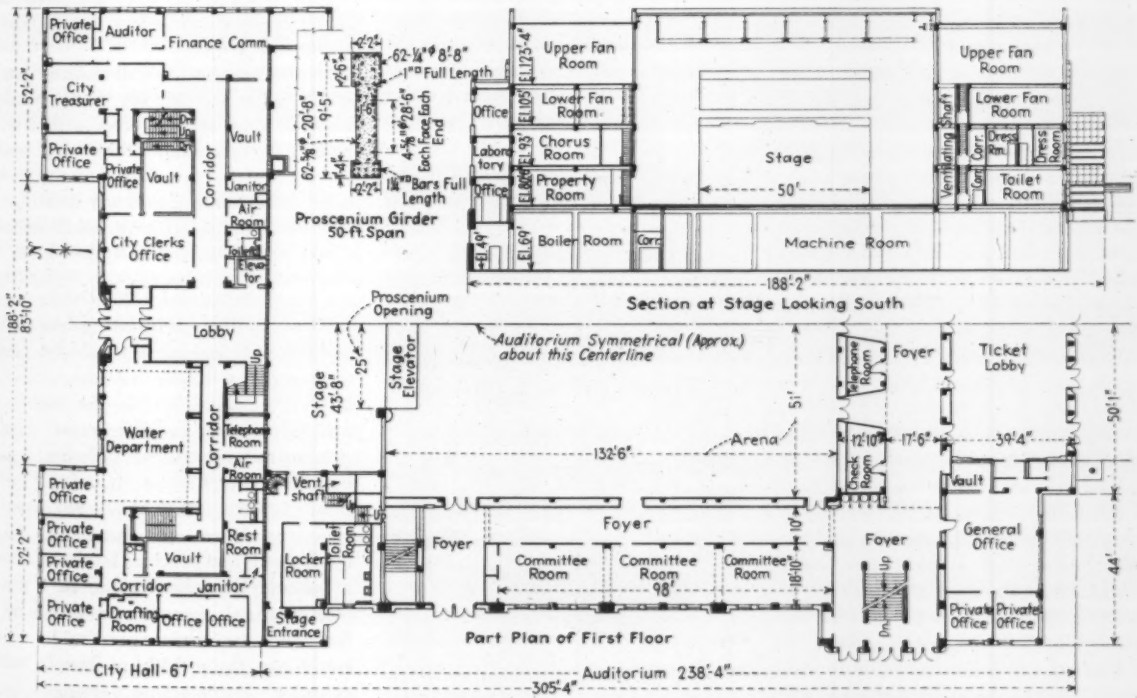



Fig. 3. First floor plan, auditorium cross section and proscenium girder details of new municipal building for Topeko, Kan.

additional rooms seating 125 people each and one large assembly room over the entrance lobby which will seat 450. This last room has a stage at one end raised above the level of the main floor.

In the front or north end of the auditorium, on either side of the stage, there are four levels of rooms. At the stage level are the equipment storage rooms, on the second floor the chorus dressing and toilet rooms, and on the third and fourth floors the fan rooms for the air conditioning and ventilating system. The entrance to the auditorium and all committee rooms will be from the south. In addition to the main entrance four exits on the two sides of the auditorium serve as a means of egress from the building. These exits and the foyers and stairways are designed so that the building can be completely evacuated in two minutes' time.

### Foundations and frame

Core drilling on the site revealed a bed of firm blue shale at relatively shallow depth, but over about one-half of the building area this was covered by a rock stratum from 4 to 9 ft. thick. The engineers decided to carry the foundations through the rock so that the entire building could be founded on the shale. Accordingly, 224 pier excavations were dug from 13 to 17 ft. below the basement floor. To eliminate the necessity for bracing, the excavated holes were made circular (Fig. 4), varying in diameter from 3 ft. 10 in. to 11½ ft., and to eliminate the necessity for carrying column forms below grade the holes were completely filled with concrete to the bottom of the basement slab. For the piers which penetrated the rock the holes were dug about one foot larger in diameter than the pier, which was then poured in a round corrugated metal form. The space outside the form was filled with sand to assure that the load would be taken to the base of the pier rather than being partly supported from the sides.

With the exception of the auditorium floor and its supports and the auditorium roof trusses, the frame of the structure is of reinforced concrete. Steel was used to support the auditorium floor in an effort to achieve a minimum number of columns of small size in the basement exhibition hall. Floor panels generally are about 25x35 ft. The roof over the main auditorium is supported on six steel trusses of 164-ft. span spaced 32 ft. 8 in. apart and weighing 30 tons each. The trusses, with an overall depth of 16½ ft., are supported on rockers and bolsters so that the entire roof structure is free to contract or expand. The concrete columns that support the trusses are 26x52 in. in section up to the base of the truss where they split into two 13x13-in. square columns. The truss shoes are placed between these square columns, which carry the upper curtain walls and the parapets.

The auditorium roof deck is made up of 14-gage steel pan sections, 13 in. wide and 6 in. deep, having a clear span of 16½ ft. between purlins. The entire roof is insulated with a 2-in. thickness of corkboard and covered with a four-ply felt built-up coal tar pitch and gravel roofing.

The heaviest member in the structure is the 50-ft. span proscenium girder of reinforced concrete. As shown in detail in Fig. 3, it has an overall depth of 9 ft. 5 in. and an overall width of 2 ft. 2 in.

### Variety of materials

An unusual variety of materials is utilized in the building to provide durability and a rich appearance. Exterior walls are of brick surfaced with stone; a pink buff Mansota stone is used for the base course while the remainder is finished with Silverdale limestone, a native stone with a warm buff color. All stone has a smooth planer finish and, with the exception of rusticated bands which carry entirely around the building at the window levels, all surfacing is done with stone cut in 2-ft. squares, with joints laid to match both vertically and horizontally. Entrance steps are of pink granite, and the approach walks and platforms are surfaced with a colorful quartzite Tennessee flagstone.

Fig. 4. These holes, 4 to 11 ft. in diameter and 17 ft. deep, filled to basement floor with concrete, serve as column footings.

The cantilevered concrete canopies on the south, east and west elevations are covered with extruded aluminum. Windows and doors on the exterior of the building are fabricated of aluminum shapes. The exterior doors and all interior aluminum trim have an anodic finish to preserve the luster and keep maintenance costs to a minimum.

Corridors and lobbies in both the city hall and auditorium units have terrazzo floors and marble wainscots and are finished with acoustic plaster. In the auditorium the main stairways leading to the balcony have non-slip terrazzo treads and ornamental railings of extruded aluminum. The walls of the arena floor to a height of 6 ft. are to be lined with a rust-red ceramic glazed tile. A similar but buff-colored tile is used on the walls of the basement exhibition area. Above the balcony level in the auditorium the walls are treated with acoustical plaster, as is the ceiling. A wood block floor covers the arena.

In the city hall, public offices generally have rubber tile floors while work spaces are covered with linoleum. Metal door trim is used throughout for interior doors. Flush type walnut and mahogany doors are used in the city hall unit, while metal doors are used in the auditorium.

### Mechanical facilities

The heating, ventilating and air conditioning equipment was designed to function with the building's many and varied uses. Within the building are 23 supply and exhaust fans, driven by a total of 117 hp., and handling 389,000 cu. ft. of air per min.

A refrigeration water cooling equipment installation is situated in a basement machine room in a central location, since it serves both office and auditorium units. In this room are three 130-ton Freon two-cylinder single-acting compressors, each driven by a 150-hp. synchronous motor and connected to shell-and-

tube-type water coolers and condensers. The entire operation of the refrigeration water cooling system is automatic, and controlled by the temperature of the leaving water through a step-type controller. The leaving water temperature required on the hottest days is 44 deg. F.

Water is pumped through the coolers by three 500-gpm centrifugal pumps to various cooling coil units situated adjacent to the conditioned spaces in the office building or auditorium. The units for auditorium, exhibition hall and assembly room are finned coil type with recirculating spray while the office building units are equipped with finned coil but without the spray.

Fresh air for the city hall section is taken from the roof directly over the air rooms, whose locations are shown in Fig. 3. Seven supply fans are used for this section of the building and one exhaust fan. For the auditorium two supply and two exhaust fans, situated in two fan rooms on each side of the stage near the roof, supply the air. Each supply fan delivers 50,000 cu.ft. and each exhaust fan 40,000 cu.ft. of air per min. Fresh air or recirculated air, in quantities determined by the operator at the control board in the engineer's room, is filtered and supplied to these main supply fans. The air is then delivered to the various spray type air units, where it is washed, heated or cooled before going into the main ducts in the attic space from which it is admitted to the auditorium through adjustable double-diffuser type grilles.

Return air is taken from the arena through grilles at the floor line and from mushrooms evenly distributed along the balcony risers. Dampers are provided and controlled from the control board in the engineer's room, so that all return air or any portion of it can be exhausted to the outside or recirculated. All exhausted air is passed over the auditorium ceiling before being exhausted to the outside, so as to reduce the heat loss from the auditorium ceiling to a minimum both in summer and winter. In addition to the above equipment the auditorium is equipped with a smoke exhaust fan and duct system to exhaust smoke through outlets around light units in the ceiling.

All supply and return ducts are insulated with 1-in. fireproof insulation board and all air units and fan housings with 2-in. fireproof insulation. All ducts on each side of the fan units are acoustically treated to prevent transmission of noise.

Fig. 5. As work began on arena enclosure. Steel roof deck is being installed as concreting progresses on fourth floor fan rooms either side of stage. Note concrete girder over stage opening.

All committee rooms and offices are heated with direct radiation, and lobbies and entrances with squirrel-cage type unit heaters supplying air at the floorline through directional flow type grilles. During the heating season hot water is supplied to the various air units by converters situated in the machine room. Fresh air to the various units is preheated with steam coils.

Humidity control is obtained during the winter months by humidistats controlling the spray pump motors on the spray type coils of the auditorium and by target type spray nozzles in the office building air units.

Provisions are made for obtaining steam at low pressure from the street main or from three 30,000-sq.ft. low pressure steel boilers in the basement boiler room. Steam is distributed throughout the building through a two-pipe up-feed heating system.

### Electrical facilities

The light and power supply for the building is taken from the power company's substation adjacent to the building. The service is three-wire 208-volt 3-phase, 60-cycles, for power; and four-wire 120-208-volt 60-cycle, for lighting. Power is distributed from a dead-front-type switchboard in the basement near the center of the building.

The lighting equipment will produce 70 foot-candles at the floor line in the auditorium, exhibition hall and assembly room. Also the auditorium ceiling is equipped with special floodlight projectors designed to produce 200 foot-candles at the floor of the arena. Lighting units are installed above the ceiling in attic spaces so that the heat from the lights can be exhausted without adding to the refrigeration load.

In addition to these electrical facilities, the auditorium is equipped with all the necessary stage lights, public address, music reproduction and radio distribution systems. Provisions are made in the exhibition hall for supplying single-phase and three-phase power from plugs situated on the columns.

### Personnel

Griest & Coolidge, Topeka, are the architects for the building, Finney & Hazard, Topeka, the structural engineers and William L. Cassell, Kansas City, Mo., mechanical engineer. F. M. Spencer & Son, Topeka, is the general contractor.

The auditorium unit of the building contains 3,011,612 cu.ft. and the city hall unit 643,258 cu.ft. or a total of 3,654,870 cu.ft. On a unit cost basis the general contract cost is 20.4c. per cu.ft., the heating, plumbing and ventilating 7.5c. per cu.ft. and the electric wiring 2.1c. per cu.ft., or a total of 30c. per cu.ft., excluding architectural or engineering fees.

FIG. 1. PULLMAN'S AIR-TREATED ENGINEERING DRAFTING ROOM, A MODERN UNIT IN A MODERN BUILDING.

# Design and Drafting Offices in Chicago

***Contents in Brief**—To meet the owner's demands for a simple and economical structure, designers first developed a flat roof, one-story layout with separate office and drafting room sections that meets all requirements. The 200-man drafting room, artificially lighted and air-treated, is finished off but, in the office section, steel-work is exposed and tile partitions are unplastered. Yet colored asphalt tile flooring, aluminum blinds and attractive paint overshadow the unfinished interior.*

EXTREME SIMPLICITY and economy in design and construction, coupled with maximum serviceability and functional efficiency, make the new engineering building of the Pullman, Ill., plant of Pullman-Standard Car Mfg. Co. an outstanding building of 1939 in its class. In common with engineering departments of many industrial corporations, the engineers at Pullman were scattered and crowded into otherwise unwanted spaces. Drafting rooms, tracing and correspondence files, blueprint and photostat machines and engineering offices were disconnected, physically uncoordinated and of difficult access. Today the entire engineering design department is housed in a new building of its own containing one large, ample drafting room, air-treated and artificially lighted, blueprint and reproduction facilities, fireproof tracing and correspondence vault, clerical and estimating offices and private offices for engineering officials.

## General design

Economy was the prime consideration. The engineering department knew what it wanted in the way of space and facilities; the management set a tentative maximum on expenditures. United Engineers & Constructors, Inc., Philadelphia, were called in as consulting engineers to work out something satisfactory to all parties and then to manage construction.

The new building faces Cottage Grove Ave. at the 109th St. gate of the Pullman Works. It consists of a single-story office section along the front, 289 x 53 ft., with provision for adding a second story, a one-story drafting room, 125 x 163 ft., at the rear, and a 24 x 35-ft. basement and a 24 x 32½-ft. penthouse to house air treatment, ventilation and other service facilities. Floor space totals 38,000 sq. ft. and contents total 524,033 cu. ft. The frame is structural steel with steel pipe columns on concrete foundations. Exterior walls are 4-in. brick backed up by 8-in. tile in the drafting room section; 13-in. solid brick elsewhere. Parapets are brick, while copings, exterior trim and window sills are limestone.

Because of the plan for a future second story over the office section, the roof slab here is 4-in. concrete; over the drafting room the roof is 2-in. gypsum plank. Roof covering throughout is built-up roofing on 1-in. insulation, copper-flashed. The first floor and basement slabs are 4-in. con-

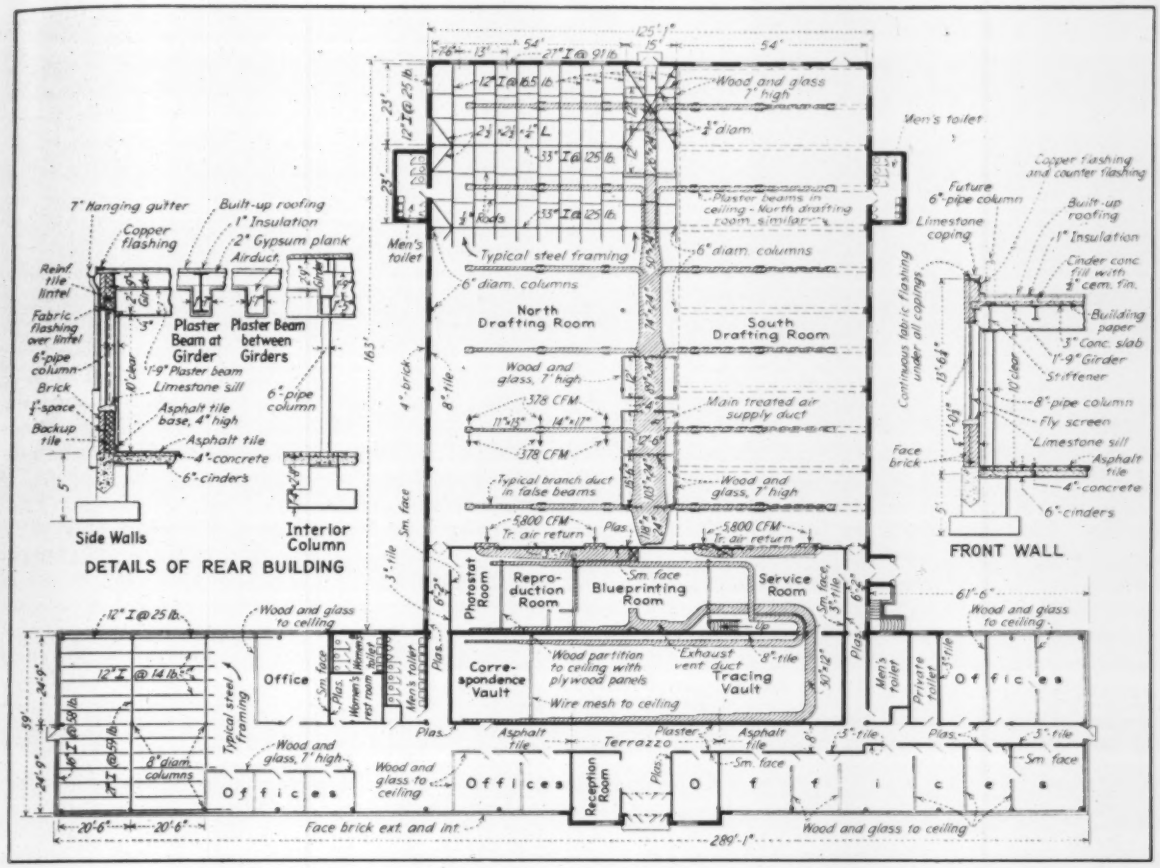



**Fig. 2.** Simplicity and economy were first considerations in design of the Pullman Engineering Building. Plaster and air treatment for drafting room were deviations from original plans, as was also face brick for front office section.

crete placed on top of 6 in. of cinders.

Windows are projected-type steel sash, glazed with d.s.A glass and equipped with fly screens. Heating is by a two-pipe vacuum steam system through cast-iron wall radiators; the supply is exhaust steam from the power plant, brought to the building at the low average pressure of 2 lb.

Floors in the toilet rooms and entrance vestibule are terrazzo; in the vault, basement and penthouse, are finished concrete; and in offices, blueprint rooms, and drafting room, are $\frac{3}{16}$-in. asphalt tile. Partitions inclosing the toilets, vault and blueprint rooms are hollow tile; office partitions are wood and glass. Toilet rooms are finished with a white ceramic tile 6 ft. high with plaster above. The plumbing includes six toilet rooms, hot and cold water system, drinking fountains and roof and floor drains.

### Drafting room

The drafting room, heart of the engineering department, was given the most study, and the result is one of the finest, most comfortable and best lighted rooms of its kind in the country. First consideration was a sawtooth, naturally lighted room. However, visits by the consultants and engineering officials to various industrial drafting rooms led to a decision against this type. It was noticed that roof leaks or condensation drips often caused damage to drawings, and that natural lighting was invariably inadequate and unsatisfactory and had to be supplemented by artificial lighting. Furthermore, the investigating group found that in plants requiring large tracings, as Pullman often uses, variations in humidity caused troublesome expansion and contraction of the tracing vellum. These studies ruled out natural lighting by skylights and sawtooth roofs. Once artificial lighting was chosen, the problem of dissipating the heat from the large number of lights suggested forced ventilation. Humidity control was considered desirable, which, with ventilation requirements, led the designers to air treatment for the drafting room, a feature not considered at first.

Because only two objectives were sought—rigid humidity control for the benefit of vellum and tracing cloth and only sufficient cooling to compensate for the excess heat dissipated by the drafting room lighting system—the system of air treatment is not considered in the normal sense of air conditioning for comfort. Nevertheless, the result is highly gratifying from the standpoint of comfort, and draftsmen work in pleasant circumstances on the hottest days, free from the necessity of protecting vellum and tracing cloth from perspiration.

The cost of the air treatment system was justified on the basis that it will pay its way through the years by economies attained in producing drawings which must, in many cases, be kept on file for 20 years, or as long as the cars remain in service. The single item of minimizing or eliminating expansion and contraction of large sheets of vellum and tracing

cloth was the starting point of this modified air-conditioning idea.

The steel framing of the drafting room was well adapted to both excellent lighting facilities and the air treatment system. Two clear working areas of 54 x 163 ft. were provided by placing two rows of columns the full length of the center of the room in a 15-ft. bay, then spanning between these and the outside walls with 33-in. 125-lb. I-beams, 54 ft. long, spaced 23 ft. apart. The main treated air supply duct runs the length of the middle longitudinal bay; transverse ducts branch out in both directions between the long beams.

Before the air treatment was decided upon, plastering of the drafting room was not contemplated. However, in order to obtain flat surfaces with proper texture and better light-reflecting values, the entire room was finally plastered, including the exterior walls. In the narrow bays between the transverse air ducts and the transverse beams are hung luminous bowl indirect lighting fixtures. The beams and ducts break up the ceiling glare, and the light on the drafting tables, which measures from 35 to 40 foot-candles, is absolutely shadowless.

In the 15-ft. longitudinal bay between the two center rows of columns have been placed several supervisors' offices, closed in by wood and glass partitions 7 ft. high. This leaves the two 54-ft.-wide spaces on either side clear for drafting tables. There is room for about 200 draftsmen, and tables are so arranged that two draftsmen use three tables, the center one being used for references.

Extending across the front end of the drafting room, except for corridors on either side leading to the office section, are the service room, the blueprint and photostat rooms, and the combined correspondence and tracing file vault. The draftsmen apply for catalogs and reference tracings at the service desk; they are not permitted to enter the vault. The service desk area, open to the drafting room, benefits from the air treatment; the other rooms in this group have forced ventilation but no air treatment.

The blueprinting facilities approach the capacity of many commercial blueprint establishments, as the daily production of blueprints from two continuous machines sometimes runs as high as 2,500 prints.

### Office section

The bare simplicity originally contemplated for the entire building has been largely retained in the front office section, though a few refinements were added during construction. For example, the original plan called for straight hard Chicago common brick throughout, but at slight additional cost a $16 red face brick (common cost $10) was adopted for the three front section exteriors and for the interior of the exterior walls in this section. Limestone, instead of the planned precast stone, was placed around the main front entrance and also replaced the early specified brick window sills. The entrance hall, reception room and corridor walls are plastered. Aluminum Venetian blinds are provided throughout.

Otherwise the front office section is extremely simple. Main partitions are painted hollow tile; minor partitions are wood and glass. Steelwork is entirely exposed, painted a cream color, as is also the under side of the roof slab forming the ceiling. All piping is exposed, painted the same cream color. However, the interior appearance of the office space is far from unattractive. The exposed steelwork and piping, while evidencing economy, are quite inconspicuous because of their uniform color. Also, the aluminum Venetian blinds, the colored asphalt tile floor and the exposed warm-colored brickwork of the exterior walls add much to the general appearance.

The office section is divided into a reception room, several private offices and a large office for clerical and estimating departments. All office space has only natural ventilation. Much of the exterior wall area is in windows, extending from sill to ceiling continuously and without pilasters, thus providing exceptional natural light.

### Services

Two refrigerating compressors, each of 40 tons rated capacity, are in the basement. These are of sufficient capacity to take care of the additional load occasioned by leaving the doors open in summer between the drafting room and offices, a situation contemplated in advance. Water, cooled by the refrigerant, is pumped to the air treating plant in the penthouse, where the air is cooled and washed. Fresh air from the outside is admitted through motor-controlled dampers into a mixing chamber, as is also part of the effluent air from the drafting room. The relation between fresh and recirculated air is automatically controlled by an outside thermostat. Maximum fresh air is admitted when the outside temperature is around 50 deg.; above and below that temperature, more air is recirculated.

From the mixing chamber the air passes through a dry filter, tempering coils, water-sprayed cooling coils and out through a 30,000-cfm fan for distribution through the drafting room ducts. Part of the effluent air passes back through grilles and ducts at the front end of the drafting room, the remainder goes out through the front office section and through small exhaust fans in the drafting room.

Mechanical ventilation—not treated air—is supplied to various parts of the building by the following fans: supply to blueprint room and vault, 5,500 cfm; exhaust from these rooms, 4,100 cfm; exhaust from toilets, four 400 and two 600 cfm; and exhaust from basement, 1,000 cfm. Toilet exhaust fans are located in the toilet rooms, other fans are in the penthouse.

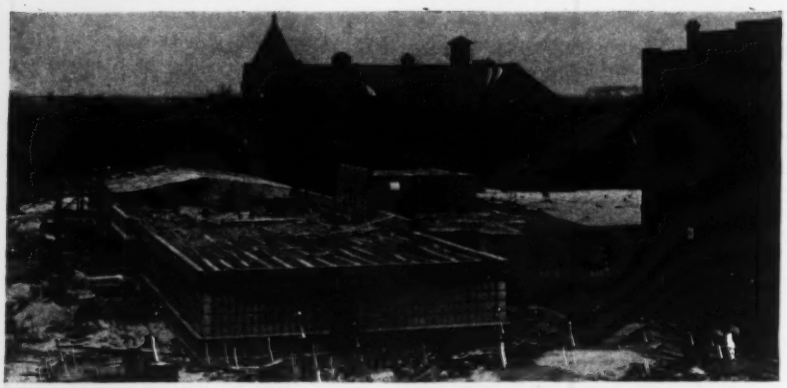


**Fig. 3.** No architectural gem, but a simple, serviceable building, the Pullman Engineering Building stands out in contrast to its older massive neighbors.

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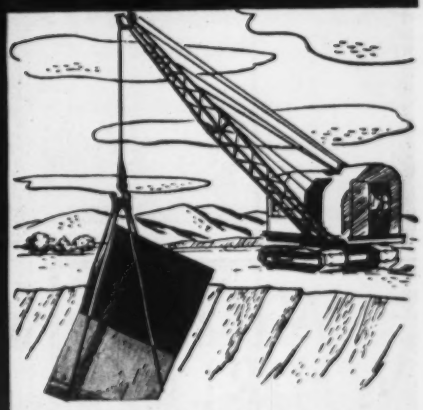

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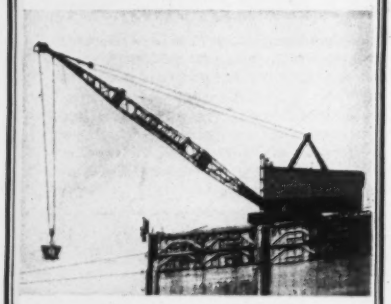

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## NEW ENGINEERING BOOKS

A BUILDER OF THE WEST—The life of General William Jackson Palmer by John S. Fisher. 332 pp. Published by the Caxton Printers, Ltd., Caldwell, Idaho. Price $3.50.

AMERICA BUILDS—The Record of PWA—Prepared by the Division of Information. 298 pp. For sale by the Superintendent of Documents, Washington, D. C. Price 70c.

MATERIALS OF CONSTRUCTION—By the late Adelbert P. Mills. Fifth Edition, rewritten and revised by Lloyd F. Rader. 564 pp. Published by John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London. Price $4.

JOHNSON'S MATERIALS OF CONSTRUCTION—By the late J. B. Johnson. Eighth edition rewritten by M. O. Withey and James Aston. 867 pp. Published by John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London. Price $6.

ENGINEERING MATERIALS—By Alfred H. White. 547 pp. Published by the McGraw-Hill Book Co., Inc., New York and London. Price $4.50.

GRAPHIC PRESENTATION—By Willard C. Brinton. 512 pp. Published by Brinton Associates, 599 Eleventh Ave., New York City. Price $5.

TRANSPORT CONTROL ABROAD—By W. Rodney Long. 427 pp. May be obtained from Superintendent of Documents, Washington, D. C. Price 40c.

ROUTE SURVEYING—By George Wellington Pickels and Carroll Carson Wiley. Second Edition. 427 pp. Published by John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London. Price $3.50.

PROTECTIVE COATINGS FOR METALS—By R. M. Burns and A. E. Schuh. 407 pp. Published by Reinhold Publishing Corp., 330 West 42nd St., New York City. Price $6.50.

THEORY OF STRUCTURES—By Charles M. Spofford. Fourth Edition. 615 pp. Published by McGraw-Hill Book Co., New York and London. Price $6.

MANAGEMENT AND THE WORKER—By F. J. Roethlisberger and William J. Dickson. 615 pp. Published by Harvard University Press, Cambridge, Mass., and Oxford University Press, London. Price $4.50.

THE COLLECTIVE LABOR AGREEMENT—By Elias Lieberman. 233 pp. Published by Harper & Brothers, New York and London. Price $3.

STEAM AND HOT WATER FITTING—by William T. Walters. 184 pp. Published by American Technical Society, Chicago.

BAUGRUND UND BAUWERK—by Franz Kogler and Alfred Scheidig. 288 pp. Published by Wilhelm Ernst & Sohn, Berlin. Price 17.65 RM cloth bound.

MANNING FORMULA TABLES, Vol. 2—by Horace Williams King. 379 pp. Published by McGraw-Hill Book Co., New York and London. Price $5.

*This book supplements an earlier book on pipe flow problems published in 1937 under the same title but not called Volume 1.*

GRANTS-IN-AID UNDER THE PUBLIC WORKS ADMINISTRATION—by J. Kerwin Williams. 292 pp. Published by Columba University Press, 2960 Broadway, New York City. Price $3.75.

## REPORTS AND PAMPHLETS

1939 SOCIAL SECURITY AMENDMENTS EXPLAINED—18 pp. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York City. Price 50c.

REINFORCED CONCRETE FUNDAMENTALS—By D. R. Cervin. 27 pp. Published by the author, 3,400 Tenth Avenue, Rock Island, Ill. Price 50c.

HIGHWAY TRANSPORTATION REMAKES AMERICA—32 pp. National Highway Users Conference, National Press Bldg., Washington, D. C.

PUBLIC WATER SUPPLIES IN VIRGINIA—Descriptions and Analyses. 159 pp. Prepared by the Bureau of Sanitary Engineering, Richmond, Va.

FLOW OF THE RIO GRANDE AND TRIBUTARY CONTRIBUTIONS—1938. Water Bulletin No. 8. 80 pp. May be obtained from International Boundary Commission, U. S. Section, 627 First National Bank Bldg., El Paso, Texas.

TEXAS—Registered Professional Engineers July 1939 Roster—Published by and obtainable from State Board of Registration for Professional Engineers, 511 Ewell Bldg., Austin, Texas.

BRITISH COLUMBIA—Year Book of the Engineering Profession, 1939. May be obtained from the Association, 930 Birks Bldg., 718 Granville St., Vancouver, B. C.

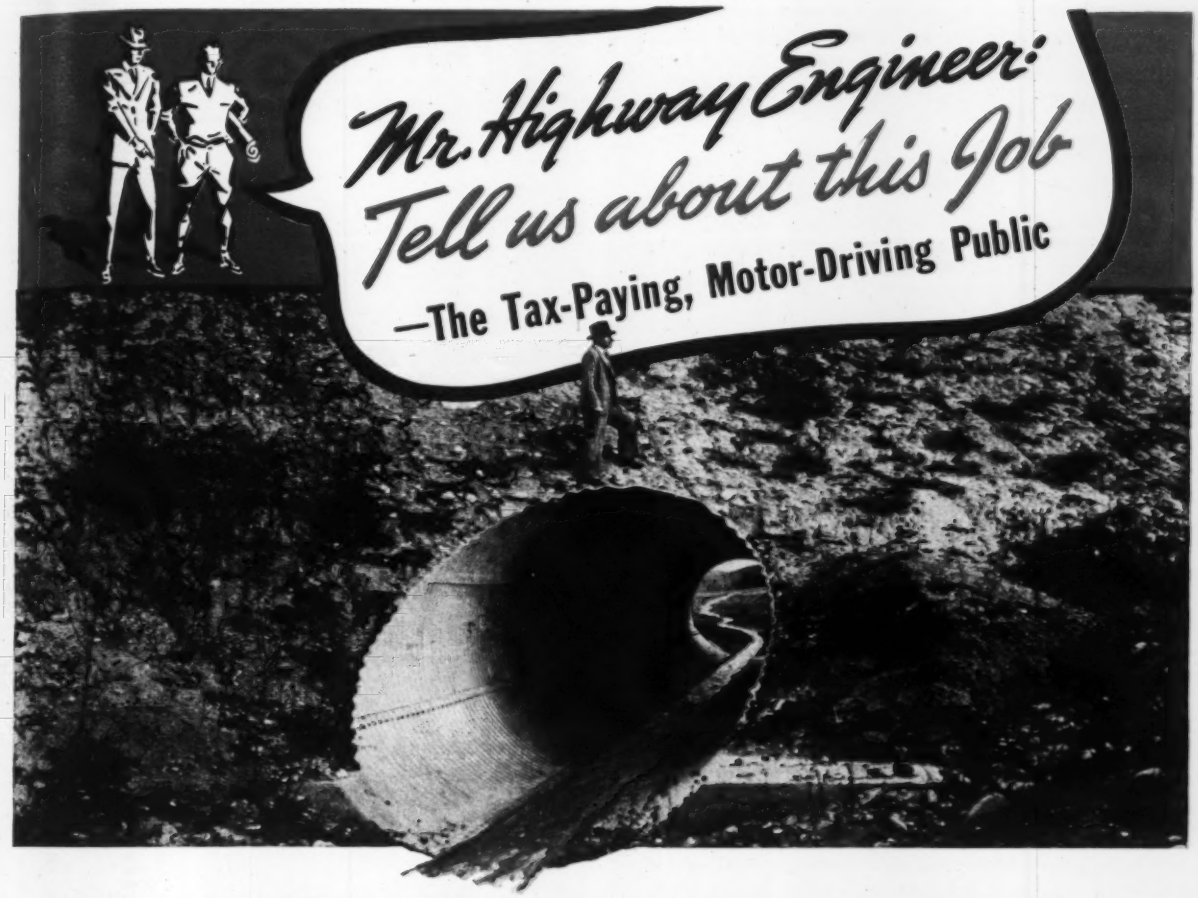
PORTLAND WATER DISTRICT, Maine—Thirty-second Annual Report, 1938.

WALTHAM, Mass.—Annual Reports of the Dept. of Public Works and Board of Survey and Planning, 1938.

ESSEX COUNTY, Mass.—Annual Report of the County Engineers, 1938. May be obtained from the Office of the County Engineer, Court House, Salem, Mass.

EGYPT—Annual Report for the Year 1931-32. May be obtained from Publication Office, Government Press, Bulac, Cairo. Price P. T. 50.

WAYNE COUNTY, Mich.—Thirty-Second Annual Report, 1938. Prepared by Board of County Road Commissioners, 3800 Barlum Tower, Detroit, Mich.

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"And you will continue to save indefinitely, because Toncan structures are *permanent* structures. They require no maintenance — and should this highway ever be relocated or abandoned, you save because these structures can be completely salvaged."

Put your construction problems up to the Toncan staff of engineers. They will help you solve them quickly and economically. Toncan Culvert Manufacturers' Association, Republic Building, Cleveland, Ohio.

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CORRUGATED PIPE • SECTIONAL PLATE PIPE AND ARCHES • SUBDRAINAGE PIPE • FLOOD GATES

TONCAN IRON — A PRODUCT OF REPUBLIC STEEL CORP.

# CONTRACT UNIT PRICES

*What contractors are bidding on different kinds of construction work*

## SANTEE DAM
## SOUTH CAROLINA

OWNER: South Carolina Public Service Authority, Charleston, S. Car.; Harza Engineering Co., Chicago and Charleston, engineers.

PROJECT: Constructing Santee Dam across Santee River and Santee Swamp at Wilson Landing, eighteen miles south of Manning and fifty miles north of Charleston, S. Car. It will be approximately 8 miles in length, extending in general north-south direction across Santee Swamp. Project includes construction of rolled fill South Dam and entrance road, dredger fill North Dam and river closure, reinforced concrete spillway dam, fabrication and installation of spillway gates, and railroad construction and operation.

CONDITIONS: Contractors to complete work in 450 days, and furnish all materials except cement, which will be furnished by owner. Highway and rail transportation facilities available, with possibility of water facilities being available later. Wage rates are: skilled, $1.00 to $1.50 per hr.; semi-skilled 50c. to $1.00 per hr.; and common labor on heavy construction, 40c. per hr.

BIDS: Bids were asked August 29, 1939 on Schedule 1, South Dam; Schedule 2, North Dam; Schedule 3, spillway dam; Schedule 4, spillway gates; Schedule 7, combination of all the above; Schedule 5, spillway dam and gate combination; Schedule 6, combination of Schedules 5 and 2; Schedule 8, railroad construction; and Schedule 9, operation of railroad. Contracts awarded for Schedules 1 through 5 separately. Contracts for Schedule 8 and 9 not to be let at this time. Bids on Schedule 1, five bidders, range from the contract low of $170,944 to $197,230; five bids on Schedule 2, from $2,420,265 to $3,516,628; five bids on Schedule 3, from $3,081,690 to $4,108,295; and on four bids on Schedule 4, from $222,500 to $264,245.

### SCHEDULE 1—SOUTH DAM AND ENTRANCE ROAD

LOW BIDDERS:

1. W. C. Sheperd, Atlanta, Ga. (contract) ..... $170,944
2. E. W. Grannis, Fayetteville, N. Car. ..... 171,185
3. C. G. Fuller, Barnwell, S. Car. ..... 183,515

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Clearing, Class B | 310 ac. | $20.00 | $40.00 | $75.00 |
| 2. Overburden drill. 2½-in. casing | 200 l. f. | 1.00 | 1.00 | 1.50 |
| 3. 2-in. soil samples | 40 ea. | 4.00 | 5.00 | 1.00 |
| 4. 6-in. auger holes | 150 l. f. | 1.00 | 2.00 | 1.00 |
| 5. Auger hole soil samples | 45 ea. | 4.00 | 5.00 | 1.50 |
| 6. 2½-in. casing, left in place | 50 l. f. | .50 | 1.00 | .75 |
| 7. 1½-in. pipe and well points | 60 l. f. | 4.00 | 2.00 | .50 |
| 8. Stripping | 110,000 c. y. | .16 | .14 | .18 |
| 9. Borrow for rolled fill | 530,000 c. y. | .19 | .19 | .18 |
| 10. Adjustment each add'l. or lesser roll | 460,000 c. y. | .0015 | .0015 | .0015 |
| 11. Earth dike embankment | 80,000 c. y. | .17 | .15 | .18 |
| 12. Roll, finish earth fill | 460,000 c. y. | .02 | .02 | .02 |
| 13. Topsoil and seeding | 18 ac. | 450.00 | 200.00 | 200.00 |
| 14. Roadway excavation | 40,000 c. y. | .225 | .28 | .30 |
| 15. Corr. rdway. culverts | 35,000 lb. | .14 | .14 | .13 |
| 16. Credit for use St. Stephens Railroad | L.S. | 1.00 | ..... | ..... |

### SCHEDULE 2—NORTH DAM AND RIVER CLOSURE

LOW BIDDERS:

1. Wilbanks & Pierce, Inc., Greenville, Miss. (contract) ..... $2,420,265
2. Construction Aggregates Co., Chicago, Ill. . 2,426,390
3. W. E. Callahan Constr. Co., Dallas, Tex. 2,526,630

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Clearing after logging | 260 ac. | $367.00 | $285.00 | $190.00 |
| 2. Clearing virgin timber | 260 ac. | 331.00 | 270.00 | 230.00 |
| 3. Clear and deliv. merch. timber | 260 ac. | 452.00 | 440.00 | 330.00 |
| 4. Overburden drill., 2½-in. casing | 2,500 l. f. | 2.75 | 1.25 | 2.50 |
| 5. 2-in. soil samples | 500 ea. | 2.50 | 1.00 | 3.00 |
| 6. 6-in. auger holes | 500 l. f. | 2.00 | .50 | 3.00 |
| 7. Auger hole soil samples | 150 ea. | 2.00 | 1.00 | 2.00 |
| 8. Test pits | 30 l. f. | 10.00 | 10.00 | 20.00 |
| 9. Test pit samples | 10 ea. | 1.50 | 2.50 | 6.00 |
| 10. 2½-in. casing, left in place | 300 l. f. | 1.00 | .40 | .40 |
| 11. 1½-in. pipe and well points | 400 l. f. | 1.75 | .30 | 2.50 |
| 12. Roadway excavation | 20,000 c. y. | .47 | .30 | .38 |
| 13. Corr. rdway. culv | 56,000 lb. | .20 | .25 | .16 |
| 14. Stripping | 1,750,000 c. y. | .2932 | .30 | .32 |
| 15. Foundation backfill | 15,000 c. y. | .32 | 1.50 | 1.40 |
| 16. Dredger borrow | 8,500,000 c. y. | .1492 | .1732 | .175 |
| 17. Steel sheet piling, 22#/s.f. | 29,000 s. f. | .855 | 1.25 | 1.35 |
| 18. River closure | L.S. | 170,000.00 | 45,000.00 | 100,000.00 |
| 19. Earth dike embankment | 4,000 c. y. | .27 | .25 | .35 |
| 20. Seeding | 95 ac. | 200.00 | 210.00 | 300.00 |
| 21. Settlement indicators, well points | 12 sec. | 350.00 | 350.00 | 650.00 |
| 22. Toe drains | 15,000 c. y. | 6.25 | 3.00 | 5.60 |
| 23. Credit, removal logging RR. | L.S. (cr.) | 4,000.00 | 24,000.00 | 25,000.00 |
| 24. Credit, use of St. Stephens RR. | L.S. (cr.) | 5,000.00 | 4,000.00 | 7,500.00 |

### SCHEDULE 3—SPILLWAY DAM

LOW BIDDERS:

1. McCarthy Improvement Co., Davenport, Iowa (contract) ..... $3,081,690
2. J. B. Britton & C. G. Fuller, Barnwell, S. Car. 3,415,093
3. United Construction Co., Winona, Minn. .... 3,435,770

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Clearing Class A | 75 ac. | $90.00 | $400.00 | $600.00 |
| 2. Overburden drill, 2½-in. casing | 3,000 l. f. | 3.00 | 1.00 | 2.50 |
| 3. 2-in. soil samples | 200 ea. | 5.00 | 1.00 | 3.00 |
| 4. Excavation | 710,000 c. y. | .55 | .58 | .20 |
| 5. Foundation trimming | 54,000 s. y. | .50 | .25 | 3.00 |
| 6. Foundation refill | 12,000 c. y. | .75 | 1.00 | 1.00 |
| 7. Use of tractor | 300 hr. | 3.50 | 5.00 | 3.88 |
| 8. Gravel drains | 17,500 c. y. | 3.60 | 5.00 | 4.00 |
| 9. Perfor. drain pipe | 160,000 lb. | .18 | .20 | .22 |
| 10. Pumping | 22,000 ac. ft. | 1.40 | 6.00 | 3.67 |
| 11. Observation wells | 125 ea. | 15.00 | 20.00 | 25.00 |
| 12. Steel sheet piling, 22#/s.f. | 145,000 s. f. | 1.00 | 1.10 | 1.37 |
| 13. Steel sheet piling, 27#/s.f. | 49,000 s. f. | 1.15 | 1.40 | 1.97 |
| 14. Class B concrete | 45,800 c. y. | 11.15 | 12.25 | 7.00 |
| 15. Class C concrete | 82,300 c. y. | 10.78 | 11.25 | 7.00 |
| 16. Forms, straight | 1,000,000 s. f. | .38 | .30 | .78 |
| 17. Forms, curved one way | 11,000 s. f. | .80 | .75 | 1.25 |
| 18. Reinforcing steel | 7,900 ton | 60.00 | 90.00 | 104.00 |
| 19. Steelwork | 203 ton | 130.00 | 200.00 | 200.00 |
| 20. Pipe and valves | 400 lb. | 2.00 | .40 | 1.00 |
| 21. Metal conduit | 15,300 lb. | .16 | .30 | .40 |
| 22. 2-in. non-metal. conduit | 100 l. f. | .50 | .40 | .64 |
| 23. 4-in. non-metal. conduit | 6,800 l. f. | .50 | .40 | .74 |
| 24. Copper grounds | 150 lb. | .62 | .40 | .90 |
| 25. Copper water stops | 4,700 lb. | 1.00 | 3.35 | 1.73 |
| 26. Rubber water stops | 3,700 l. f. | 1.20 | 1.85 | 1.90 |
| 27. Lighting fixtures | L.S. | 3,000.00 | 1,200.00 | 2,000.00 |
| 28. Timber crib | 1,700 l. f. | 10.00 | 5.00 | 7.60 |
| 29. Diversion closure | L.S. | 10,000.00 | 30,000.00 | 54,712.19 |
| 30. Clearing, Class B | 10 ac. | 60.00 | 100.00 | 500.00 |
| 31. 6-in. auger holes | 50 l. f. | 2.00 | 1.00 | 2.00 |
| 32. Auger hole soil samples | 15 ea. | 5.00 | 1.50 | 1.50 |
| 33. 1½-in. pipe and well points | 20 l. f. | 2.00 | 2.00 | 1.20 |
| 34. Stripping | 10,000 c. y. | .20 | .20 | .20 |
| 35. Borrow for rolled fill | 120,000 c. y. | .20 | .25 | .25 |
| 36. Adjust. each add. or lesser roll | 110,000 c. y. | .0015 | .0015 | .0015 |
| 37. Roll and finish earth fill | 110,000 c. y. | .05 | .04 | .13 |
| 38. Topsoil and seeding | 2 ac. | 400.00 | 400.00 | 500.00 |
| 39. Tile and catch basin | L.S. | 300.00 | 1,000.00 | 950.00 |
| 40. Steel pile interlock filler | 130,000 l. f. | .10 | .05 | .04 |
| 41. Santee River trestle | L.S. | 30,000.00 | 25,000.00 | 20,000.00 |
| 42. Medical, surgical care | L.S. | 10,000.00 | 5,000.00 | 13,500.00 |
| 43. Credit, use of St. Stephens RR. | L.S. (cr.) | 108,000.00 | 150,000.00 | 160,288.77 |

### SCHEDULE 4—FURNISH AND INSTALL SPILLWAY GATES

LOW BIDDERS:

1. Virginia Bridge Co., Roanoke, Va. (contract) $222,500
2. Nashville Bridge Co., Nashville, Tenn. ..... 224,750
3. J. B. Britton & C. G. Fuller, Barnwell, S. Car. 244,000

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Fabr., furn., install 62 gates | L.S. | $224,000.00 | $225,750.00 | $243,000.00 |
| 2. Gate stoplog frame | 1 ea. | 4,600.00 | 4,000.00 | 4,000.00 |
| 3. Credit for use of St. Stephens R.R. | L.S. (cr.) | 6,100.00 | 5,000.00 | 3,000.00 |

(*Contract Unit Prices continued on page* 100)

# The Mixers are *humming* on Penn Turnpike!

## CONCRETE chosen for safety and economy

The designers of the Pennsylvania Turnpike planned it to be one of the safest and most thoroughly modern highways in America. 2½ *million square yards of concrete* has been completed to date or is under contract!

### Designed—*and surfaced*—for safety

The Turnpike has separated traffic lanes . . . maximum sight distance, no grade greater than 3%, only one curve per mile . . . ramps for vehicles entering and leaving main traffic streams . . . no highway or railway crossings at grade.

**And its pavement is even-surfaced *concrete*—skid-resistant, wet or dry—assuring high visibility night and day—utmost driving safety at all times.**

### Paved for low annual cost

Long range economy naturally was given serious consideration on this road. The long life and low maintenance of concrete will assure lowest transportation cost here, as it will for *your* roads whether traffic is many thousands or a few hundred vehicles daily.

● South Penn Tunnel Highway is 160 miles in length. Two 24-ft. pavements with 10-ft. dividing strip except in tunnels where roadway is reduced to two 11½-ft. lanes each way. Highway includes 7 miles of tunnel. Built by Pennsylvania Turnpike Commission; Walter A. Jones, *Chairman;* Samuel W. Marshall, *Chief Engineer.*

**PORTLAND CEMENT ASSOCIATION**
**Dept. A10d-17, 33 W. Grand Ave., Chicago, Ill.**

***A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work.***

(Contract Unit Prices continued from page 98.)

## TRANSMISSION LINES, OREGON

OWNER: Bonneville Project, 811 N. E. Oregon St., Portland, Ore. Charles E. Carey, engineer.

PROJECT: Erecting towers and stringing 235 miles of conductor for Bonneville-Coulee transmission line of Bonneville Transmission System.

CONDITIONS: Project to be completed in 345 days. Highway transportation facilities available. Government to furnish tower steel, insulators, line hardware, conductor and conductor splice connectors, repair sleeves, dead end connectors, jumper materials, fittings, conductor splicing tools, armor rods, armor rod wrenches, armor rod clamps, ground wire cables and ground wire cable fittings, ground rods, clamps, ground wire, and ground wire clamps and bolts. Contractor to furnish all other materials. Minimum wage rates specified are: skilled, $1.00 to $1.50 per hr.; semi-skilled, 75 to 87½c. per hr.; and common, 62½c. per hr.

BIDS: Two bids were received June 15, 1939, the contract low of $947,726, and $1,062,592.

LOW BIDDERS:

1. Fritz Ziebarth, Long Beach, Calif..... $947,726
2. Associated Constructors, Los Angeles, Calif. 1,062,592

SCHEDULE 1—TOWER FOUNDATIONS

| Item | Quan. | Unit Prices (1) | (2) |
|---|---|---|---|
| 1. Conc. tower fndn., type A | 78 ea. | $500.00 | $5[illegible]0.00 |
| 2. Conc. tower fndn., type B | 97 ea. | 550.00 | 580.00 |
| 3. Conc. tower fndn., type C | 5 ea. | 1,000.00 | 1,000.00 |
| 4. Conc. tower fndn., type D | 28 ea. | 2,450.00 | 2,800.00 |
| 5. Conc. tower fndn., type E | 1 ea. | 625.00 | 700.00 |
| 6. Grillage tower fndn., type A | 866 ea. | 225.00 | 280.00 |
| 7. Grillage tower fndn., type B | 40 ea. | 350.00 | 340.00 |
| 8. Grillage tower fndn., type C | 7 ea. | 600.00 | 500.00 |
| 9. Grillage tower fndn., type D | 25 ea. | 1,000.00 | 1,000.00 |
| 10. Grillage tower fndn., type E | 5 ea. | 410.00 | 380.00 |
| 11. Uncl. excav., spec. fndn | 5,800 c. y. | 4.80 | 4.00 |
| 12. Rock excav., foundations | 13,096 c. y. | 7.50 | 6.00 |
| 13. Piling, spec. fndn | 3,400 l. f. | 1.00 | 1.50 |
| 14. Drill and grout for reinf. steelanchor dowels | 1,800 l. f. | 1.00 | 1.00 |
| 15. Reinf. steel, spec. fndn | 25,000 lb. | .08 | .07 |
| 16. Concrete, spec. fndn | 1,000 c. y. | 30.00 | 26.00 |
| 17. Struct. steel, spec. fndn | 9,100 lb. | .04 | .025 |
| 18. Ground connections, accessories | 3,200 lb. | .50 | .65 |

SCHEDULE 2—TOWER ERECTION

| Item | Quan. | Unit Prices (1) | (2) |
|---|---|---|---|
| 1. 50-ft. type A1 tower | 521 ea. | $140.00 | $176.00 |
| 2. 70-ft. type A1 tower | 398 ea. | 182.00 | 230.00 |
| 3. 50-ft. type A2 tower | 4 ea. | 150.00 | 180.00 |
| 4. 70-ft. type A2 tower | 22 ea. | 185.00 | 230.00 |
| 5. 50-ft. type B1 tower | 23 ea. | 165.00 | 210.00 |
| 6. 70-ft. type B1 tower | 72 ea. | 210.00 | 270.00 |
| 7. 50-ft. type B2 tower | 6 ea. | 165.00 | 215.00 |
| 8. 70-ft. type B2 tower | 36 ea. | 215.00 | 275.00 |
| 9. 50-ft. type C1 tower | 5 ea. | 215.00 | 265.00 |
| 10. 70-ft. type C1 tower | 7 ea. | 260.00 | 330.00 |
| 11. 42-ft. type D1 tower | 15 ea. | 285.00 | 365.00 |
| 12. 62-ft. type D1 tower | 38 ea. | 365.00 | 460.00 |
| 13. 50-ft. type E tower | 5 ea. | 195.00 | 250.00 |
| 14. 70-ft. type E tower | 1 ea. | 260.00 | 325.00 |
| 15. Ground wire bracket, type A | 22 ea. | 18.00 | 10.00 |
| 16. Ground wire bracket, type B | 6 ea. | 18.00 | 9.00 |
| 17. Ground wire bracket, type C | 10 ea. | 40.00 | 22.00 |
| 18. Ground wire bracket, type D | 10 ea. | 40.00 | 22.00 |
| 19. Steel, leg extensions | 2,435,544 lb. | .02 | .017 |
| 20. Steel, spec. structures | 197,680 lb. | .035 | .025 |
| 21. Airway lighting, Columbia River crossing | L.S. | 1,000.00 | 950.00 |
| 22. Airway marking, Columbia River crossing | L.S. | 1,000.00 | 1,700.00 |

SCHEDULE 3—STRINGING CONDUCTOR

| Item | Quan. | Unit Prices (1) | (2) |
|---|---|---|---|
| 1. String 3 conductor line, incl. splices, dead end connectors, armor rod assem., insulators, hardware, hold-down weights and appurtenances | 234.75 circ. mile | $490.00 | $650.00 |
| 2. String 2 ground wires, incl. dead ending, splicing and attaching to towers | 4.75 circ. mile | 400.00 | 320.00 |

## HIGHWAY AND BRIDGE ALABAMA

OWNER: Alabama State Highway Department, Montgomery, Ala.

PROJECT: Constructing 7.142 miles of Butler-York Road, double bituminous surface treatment highway, in Choctaw County, Alabama, and reinforced concrete and steel bridges in connection with roadwork.

CONDITIONS: Contractor to furnish all materials and to finish road work in 240 working days. Bridges must be completed in 150 working days. Rail and highway transportation facilities. Wage rates are: skilled, 85c. per hr.; semi-skilled, 40c. per hr.; and common, 25c. per hr.

BIDS: Thirteen bids were received August 11, 1939 for roadwork, ranging from the contract low of $115,549 to $136,871. Eleven bids were opened at the same time for the bridge construction ranging from the contract low of $45,085 to $58,616.

ROADWAY

LOW BIDDERS:

1. Noonan Constr. Co., Pensacola, Fla..... $115,549
2. Vandigriff Const. Co., Montgomery, Ala..... 120,736
3. C. C. Moore, Panama City, Fla..... 121,751

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Clear and grub, rt.-of-way | L.S. | $3,700.00 | $4,000.00 | $5,150.00 |
| 2. Clear and grub, beyond rt.-of-way | 7 ac. | 60.00 | 25.00 | 50.00 |
| 3. Remove structures | L.S. | 280.00 | 390.00 | 430.00 |
| 4. New material, etc. | L.S. | 47.00 | 170.00 | 50.00 |
| 5. Reset fence | 50,000 l. f. | .02 | .02 | .03 |
| 6. Common excavation | 207,000 c. y. | .17 | .195 | .16 |
| 7. Uncl. culv. excav. | 575 c. y. | 1.00 | .75 | 1.00 |
| 8. Overhaul on excav | 90,000 y. sta. | .01 | .005 | .01 |
| 9. Grassing | 204,000 s. y. | .02 | .02 | .02 |
| 10. Top soil or sand clay base crse. | 37,000 c. y. | .35 | .34 | .37 |
| 11. ½ mi. haul on base | 240,500 c. y. | .02 | .025 | .02 |
| 12. Roadbed topping mat'l | 28,350 c. y. | .21 | .225 | .37 |
| 13. ½ mi. haul on topping | 4,500 c. y. | .05 | .03 | .02 |
| 14. Single surf. asph. trtmt | 83,500 s. y. | .13 | .12 | .11 |
| 15. Plant mix seal | 83,500 s. y. | .116 | .10 | .13 |
| 16. Conc. culv. A, new | 382.5 c. y. | 19.00 | 20.00 | 22.00 |
| 17. Headwall conc. B | 51.17 c. y. | 22.00 | 22.00 | 30.00 |
| 18. Deformed reinf. bar | 59,196 lb. | .038 | .04 | .04 |
| 19. 18-in. corr. met. pipe | 393 l. f. | 1.20 | 1.25* | 1.25 |
| 20. 24-in. corr. met. pipe | 60 l. f. | 2.00 | 2.00* | 1.75 |
| 21. 30-in. corr. met. pipe | 21 l. f. | 2.40 | 3.00* | 3.75 |
| 22. 18-in. conc. pipe | 1,344 l. f. | 1.40 | 1.50 | 1.50 |
| 23. 24-in. conc. pipe | 381 l. f. | 2.40 | 2.50 | 2.00 |
| 24. 30-in. conc. pipe | 72 l. f. | 3.30 | 3.50 | 4.00 |
| 25. 18-in. conc. pipe, ext. str | 327 l. f. | 1.80 | 1.60 | 1.75 |
| 26. 24-in. conc. pipe, ext. str | 249 l. f. | 3.00 | 2.60 | 3.25 |
| 27. 6-in. title or corr. met. drain | 1,000 l. f. | .70 | .75 | .50 |
| 28. Bermuda ditch checks | 7,100 s. y. | .32 | .40 | .30 |
| 29. Wire rope | 19,305 l. f. | .08 | .085 | .08 |
| 30. Tr. timber piles | 447 ea. | 5.00 | 4.50 | 5.00 |
| 31. Anchors | 40 ea. | 10.00 | 10.00 | 10.00 |
| 32. Pit moves | 3 ea. | 90.00 | 15.00 | 25.00 |
| 33. Right-of-way markers | 126 ea. | 2.00 | 2.00 | 2.00 |
| 34. Top soil | 2,000 c. y. | .30 | .50 | .40 |
| 35. Gutter board | 5 M.b.m. | 40.00 | 60.00 | 70.00 |
| 36. Stripping excav. | 7,500 c. y. | .10 | .10 | .10 |

* Concrete pipe, "B." † Concrete posts.

BRIDGES

LOW BIDDERS:

1. Noonan Constr. Co., Pensacola, Fla..... $45,085
2. Sanders & Perkins, Hinesville, Ga..... 48,498
3. Goodwin & Murphree, Troy, Ala..... 48,716

| Item | Quan. | Unit Prices (1) | (2) | (3) |
|---|---|---|---|---|
| 1. Cl. A conc., bridge | 770 c. y. | $21.25 | $25.00 | $23.00 |
| 2. Deformed reinf. bars | 134,500 lb. | .038 | .04 | .04 |
| 3. Structural steel | 250,000 lb. | .05 | .046 | .05 |
| 4. Cl. 1 excav., bridge | 400 c. y. | 1.00 | 2.00 | 1.50 |
| 5. Cl. 2 excav., bridge | 100 c. y. | 6.00 | 10.00 | 5.00 |
| 6. Pile splices | 30 ea. | 8.00 | 8.00 | 8.00 |
| 7. Furn. steel piles | 5,016 l. f. | 1.15 | 1.20 | .80 |
| 8. Drive steel piles | 5,016 l. f. | .48 | .53 | .80 |
| 9. Furn. untr. timber piles | 1,100 l. f. | .20 | .40 | .30 |
| 10. Steel test piles | 4 ea. | 100.00 | 150.00 | 150.00 |
| 11. Drive untr. timber piles | 1,100 l. f. | .25 | .10 | .30 |
| 12. Remove old bridge | L.S. | 300.00 | 400.00 | 750.00 |
| 13. Temp. br. and detour | L.S. | 500.00 | 100.00 | 1,750.00 |

# 4th FEATURE OF AN EFFICIENT, LOW-COST WATER SYSTEM } SUSTAINED HIGH CARRYING CAPACITY

(*Left*) **SMOOTH INTERIOR OF J-M TRANSITE** gives higher delivery capacity with smaller pipe. Pumping costs are unusually low right at the start. And they *stay* low, for Transite is entirely non-metallic, cannot tuberculate under any condition.

(*Below*) **ASBESTOS-CEMENT** in composition, Transite Pipe is strong and durable, completely immune to electrolysis. Its exceptional resistance to soil corrosion keeps maintenance permanently low.

(*Above*) **LOW INSTALLATION COSTS** are a feature of Transite Pipe lines. Supplied in long, light lengths, this modern material is easy and economical to handle. Simplex Couplings are quickly assembled . . . form tight joints that minimize costly water loss.

BECAUSE of the smooth surface of the polished steel mandrel on which it is made, J-M Transite Pressure Pipe has an unusually smooth interior surface. Its initial flow coefficient is C=140. As a result, carrying capacity is exceptionally high . . . pumping costs stay low.

In service, Transite makes many other important savings. Asbestos-cement in composition, its high carrying capacity can never be reduced by tuberculation. Tight, easily assembled Simplex Couplings virtually eliminate joint leakage. And, because J-M Transite Pipe is entirely inorganic and non-metallic, it offers exceptional resistance to all forms of soil corrosion. Maintenance is negligible throughout the system's long life.

Furthermore, Transite's light weight, long lengths and simple assembly make installation easy and economical. For details on its 25-year service record, send for Transite Water Pipe brochure TR-11A. And if sewage disposal is your problem, get Transite Sewer Pipe brochure TR-21A. Johns-Manville, 22 East 40th Street, New York, N. Y.

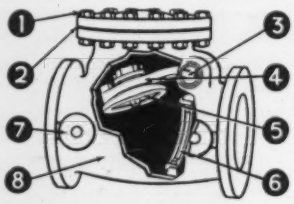
JM

## Johns-Manville TRANSITE PIPE AN ASBESTOS PRODUCT

*THE MODERN MATERIAL FOR WATER AND SEWER LINES*

JENKINS
IRON VALVES
MEAN EXTRA
SAVINGS

Check these
Service-Proved Features



1 Rugged Through-Bolts
2 High Pressure Asbestos Gasket
3 Machined Bronze Side Plugs
4 Sturdy Hanger Assembly
5 Heavy Duty Bronze Disc
6 Renewable Bronze Seat Ring
7 Convenient Bosses
8 Iron *Exceeds* A.S.T.M. Standards

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IRON VALUE
—THERE ARE 101 OTHERS!

Fig 624—125 lb. Regrinding Swing Check Valve

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ANNIVERSARY
1864 1939

JENKINS BROS., 80 White Street, New York, N.Y.; Bridgeport, Conn.; Atlanta; Boston; Chicago; Houston; Philadelphia; Montreal, Canada; London, England

(*News continued from p. 37*)

# MEN AND JOBS

LT. COL. DONALD A. DAVISON, in charge of the U. S. Engineers Office at Louisville, Ky., since July, 1937, has been transferred to active duty with the 21st Engineers at Fort Benning, Ga. Col. Davison is one of 25 engineering officers shifted from rivers and harbors work to combat units in keeping with the Army's expansion. COL. WARREN N. UNDERWOOD, head of the flood control division at Louisville since Sept. 1938, has been transferred to the 18th Engineers, Fort Devens, Mass. CAPT. LESTER F. RHODES will take charge of the Louisville office when the changes are completed.

W. P. KANTO, civil engineering graduate from North Carolina State College with the Class of 1934, has resigned as town manager at Apex, N. C., to accept a similar position at Norton, Va. Before going to Apex as town manager, Kanto worked two years with the U. S. army engineers on the Cape Fear River project at Wilmington, N. C., and for a short time with the North Carolina Highway and Public Works Commission. T. LEW CORDLE, now town manager at Fuquay Springs, N. C., is expected to take Kanto's place.

SAUL L. JOSEPH, WILLIAM H. DOYLE, and ELLA L. LEIST, all of Baltimore, Md., have organized the Paramount Construction Co., Inc., with offices in Baltimore.

W. H. MACARTNEY, engineer of St. Catherines, Ontario, has been named chairman of the technical council, formed to coordinate the activities of various technical bodies throughout the Niagara Peninsula.

D. S. BETCONE, construction engineer, was recently selected by the Douglas Fir Plywood Association as its midwestern field representative. Betcone will have his headquarters in Chicago and is to act as a technical adviser for the varied uses of Douglas fir plywood. He will also act as sales promotion contact man throughout the Middle West. He has had 24 years of experience in all types of building construction and was retained as consulting research engineer for two years by the Blaw-Knox Co. and Carnegie-Illinois Steel Corp. From 1935 to 1937 he was president of Steel Buildings, Inc. Also for ten years he was with the Modern Home Department of Sears, Roebuck & Co. Earlier in his career he spent a decade with the Alladin Co.

of Bay City, Mich., as chief draftsman and superintendent of construction.

N. B. BENNETT, formerly an engineer with the Indian Irrigation Service in South Dakota, has been made assistant state engineer of Wyoming.

RAY L. ALLIN, former engineer for Hetch Hetchy water supply, San Francisco Public Utilities Commission, has been retained by the Marin Municipal Water District to arrange plans for the enlargement of Alpine Dam.

R. L. DONLEY, a soils testing engineer on Sunshine Dam in Wyoming, has received an appointment as civil engineering instructor at the University of Wyoming.

CHARLES S. HAZEN, assistant engineer with the Bureau of Reclamation, has been transferred to Helena, Mont., where he is working on project investigations.

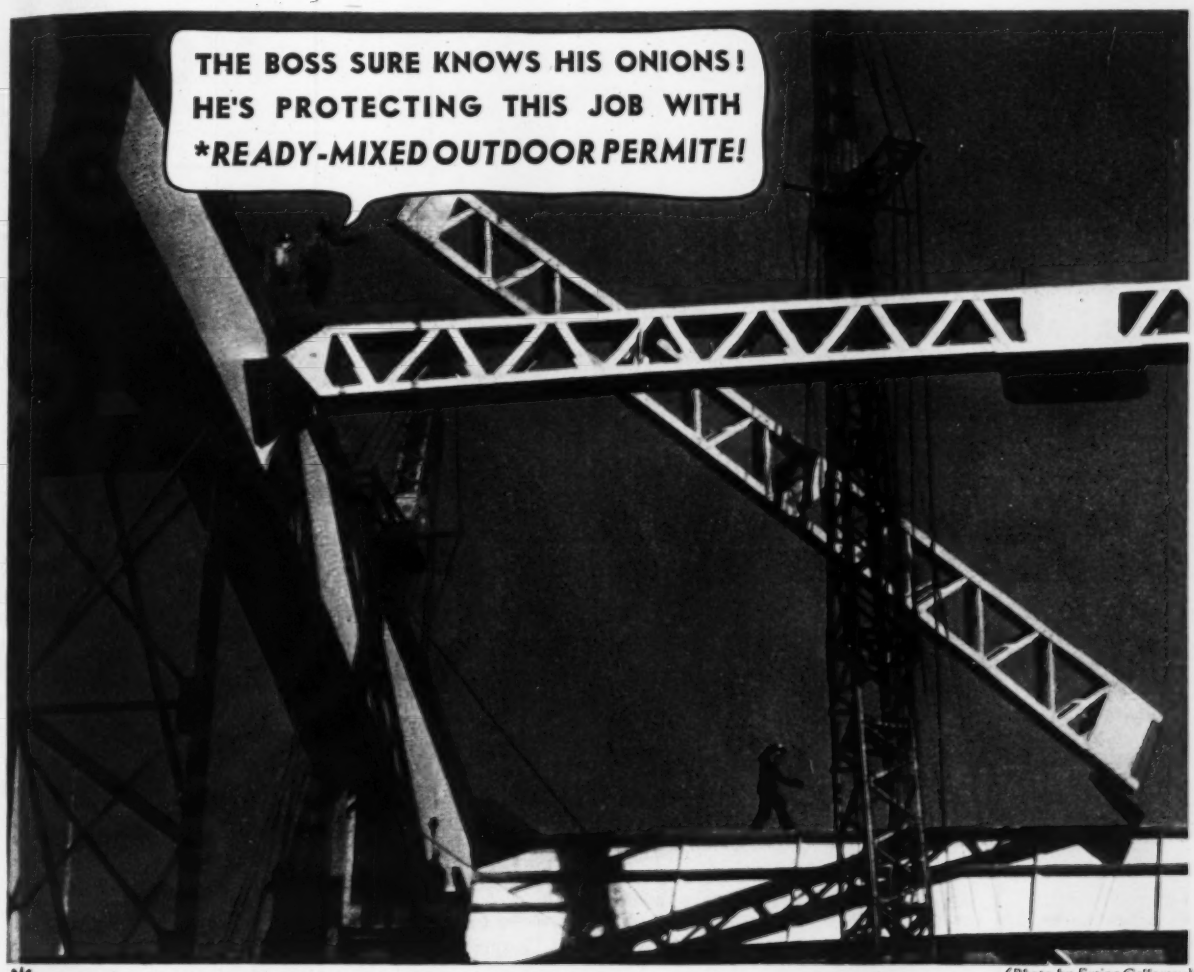
LEWIS R. MEISENHALTER, Philadelphia, GUY F. RUTAN, Dauphin County, Pa., and ROBERT A. RAMSEY, Greensburg, Pa., are engineers who recently joined the staff of the Pennsylvania General State Authority.

ARTHUR R. ROSS, civil engineer associated with the construction of the Chain of Rocks Bridge across the Mississippi River above St. Louis, has been appointed superintendent of the rail deck of the Municipal Bridge at St. Louis. Ross was general supervisor in the building of the new Municipal Bridge approaches. He has been associate to the president of the board of public service in St. Louis.

FRED UNGER has been named superintendent of works for the city of Brantford, Ont.

LT. COM. C. T. DICKMAN, Civil Engineering Corps, U. S. Navy, has been transferred from Marine Barracks, Quantico, Va., to the Navy Yard, Pearl Harbor, T. H., for duty in connection with drydock construction. LT. THOMAS L. DAVEY, Naval Operating Base, San Diego, Calif., is another engineer ordered to report for duty at the Pearl Harbor Navy Yard.

WILLARD H. CAULKINS, of Springfield, Pa., and ROBERT J. SULLIVAN, of Coatesville, Pa., are two engineers who have been appointed to the Pennsylvania




(Photo by Ewing Galloway)

# *READY-MIXED OUTDOOR PERMITE IS THE ALUMINUM PAINT (Produced Especially) FOR THE CONSTRUCTION FIELD

*METAL-LIKE PROTECTION for* BRIDGES • BUILDINGS • CHIMNEYS • CRANES • DERRICKS • DOCKS • FENCES • GAS HOLDERS • RAILROAD CARS & EQUIPMENT • ROAD EQUIPMENT • MACHINERY • STACKS • TRACTORS • TRUCKS • TANKS • TOWERS • HANGARS • Etc.

***New Permite Paint Manual Tells How, Why and Where***

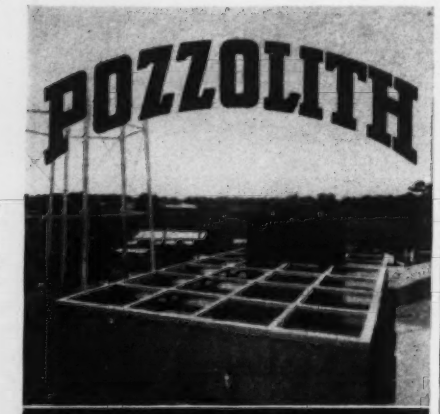
One of the most complete manuals ever published on why, how and where to use aluminum paints. Free to buyers of industrial paints. Write for your copy.

**OUTDOOR PERMITE** saves in 3 ways! Produced in the world's only exclusive aluminum paint plant, Outdoor Permite Ready-Mixed Aluminum Paint seals all types of surfaces against heat, cold, rain, wind, steam, smoke, fumes. *Secondly:* users say "Outdoor Permite costs less by the foot" because it goes farther. *Third:* no time is lost in wasteful mixing because Outdoor Permite is *ready-mixed!* And the specially treated and stabilized Permite pigment does not harden in the can, does not discolor. Leftovers can be used next day, next week, next year — with uniform results.

There is a Permite Ready-Mixed Aluminum Paint for every painting requirement, outdoors and indoors. Write for complete details or ask your supply house. Distributors in principal cities. Aluminum Industries, Inc., Cincinnati, Ohio.

## PERMITE READY MIXED ALUMINUM PAINTS

COST LESS "BY THE FOOT"




Seven Day Strength of POZZOLITH CONCRETE ··· 5,139 Pounds Per Sq. Inch

"The Pozzolith used has far exceeded our expectations," says Mr. C. Kenneth S. Dodd, Consulting Engineer on the Areator Basin, Sarasota, Florida. "I am so well pleased with it that it will be incorporated in all future specifications."

"I am recently in receipt of a test report for 7 day strength of 5,139 pounds per square inch on the cylinders taken from the floor in which the total water amounted to 4.5 gallons per sack, and the slump was five inches. Seven day strength specified was 1,750 pounds per square inch . . . The contractor is as well pleased with it as we are." Class A concrete. 1.5 bbls. cement per cu. yd.

Similar Pozzolith performance is available . . . send for it today . . . it tells how others are building more durable, watertight concrete, easily and economically.

**SEND FOR THIS IMPORTANT TEST!**

Freezing and thawing tests on Pozzolith concrete made by a leading university laboratory — authority in concrete research — show concrete durability is tripled by Pozzolith. Your copy of this report sent free upon request.

*Send for full information to*

**THE MASTER BUILDERS COMPANY**
**Cleveland, Ohio**

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MASTER BUILDERS


State Highway Department staff for district No. 6 with headquarters at Ardmore.

F. O. DUFOUR, regional engineer for PWA, has been appointed PWA project engineer in charge of Pennsylvania General State Authority program, with offices in New York and Harrisburg. FRANK R. CREEDON, assistant regional director, will take over Dufour's duties as regional engineer.

F. E. DENNIE, for the past several years city engineer at Rolla, Mo., has resigned. He is being succeeded by J. F. KILPATRICK.

RUFE B. NEWMAN, JR., Knoxville, Tenn., has been appointed assistant director of PWA for region No. 3. With his new duties he will cover PWA activities in nine southwestern states.

MAJOR W. H. BEAKE, has been named district engineer in charge of all emergency construction in military district No. 7 in Canada. His headquarters will be at St. John, N. B.

CHALMERS J. MACKENZIE, dean of the college of engineering at the University of Saskatchewan, was appointed acting president of the national research council of Canada to take over the duties of Maj. Gen. A. G. L. MacNaughton, now engaged in war duties. Mackenzie graduated from Dalhousie University and later received a master's degree from Harvard University.

COLIN CAMPBELL, Ontario minister of public works, Ontario provincial government, has joined the Royal Canadian Engineers for war service. During his absence, his duties will be taken over by Premier Mitchell Hepburn.

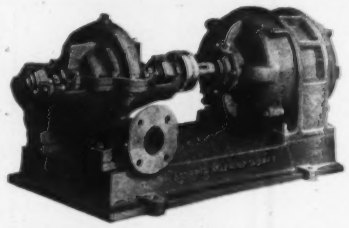
WILFRED W. DAVIS, Iowa State Highway Commission, has received a fellowship to study in the bureau of street traffic research at Yale University.

D. W. PORTER, formerly at Austin with the engineering staff of the Texas board of water engineers, has been named engineer of Hill County, Tex. His new duties will begin Nov. 1 and he will succeed John H. Robertson.

JAMES A. MCGEADY, chief WPA engineer for the Durham, N. C. area, has changed the supervision of construction projects in his area by shifting various engineers. With the changes, J. M. COLEMAN, JR., formerly in charge of Wake County, will supervise some construction work in Durham County. O. C. GOODWIN, in charge of three counties, will help direct projects in Durham County. All WPA construction work in Chatham, Orange, Alamance and Caswell counties will be directed by G. P. PHILLIPS, supervisor of proj-


The MORRIS HYDRAULIC COLUMN

*News of interest to Centrifugal Pump Users*



**50% more capacity with the same power!**

A southern plant needed more pumping capacity. The engineer came to Morris for advice. The result—a single stage Morris Pump which gave them 50% more water at the same head as from the old two-stage pump, *using the same motor as before.* If you need more capacity, or if your pumping costs are high, investigate Morris designs for your requirements. Seventy-five years of centrifugal pump-building experience makes Morris recommendations authoritative.

**Non-clogging for sewage Service**

Morris Sewage Pumps prevent clogging troubles, and assure continuous trouble-free operation even when handling heavy pulp and trash. They are extremely efficient, and have heavy wearing parts that minimize renewal expense, and the inside is easily reached.

These units are built both vertical and horizontal, for direct connection to standard-speed motors, and in sizes ranging from 3 to 30 in.

Larger axial flow and screw pumps are also built, with efficiencies well above 90%.

MEMBER

For authoritative recommendations on any pumping or dredging problem, write to Morris Machine Works, Baldwinsville, N. Y. Representatives in principal localities. *Export Office*, 30 Church St., New York.

ects in Chatham County. T. D. HEFFNER will be the supervisor for engineering projects from Warren, Vance, Franklin, Granville and Person counties.

H. G. SCHLOEMER, Davenport, Ia., has been appointed city building inspector at Davenport, to succeed A. S. BISBEE, who resigned recently. Schloemer was superintendent for the Arnold Construction Co. for many years.

## MEETINGS

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, fall meeting Atlanta, Ga., Oct. 30-31.

AMERICAN MUNICIPAL ASSOCIATION, sixteenth annual conference, Chicago, Ill., November 1-3.

NATIONAL RECLAMATION ASSOCIATION, annual convention, Denver, Colo., November 14-16. Directors meeting Nov. 12-13.

AIR HYGIENE FOUNDATION, annual meeting, Mellon Institute, Pittsburgh, Pa., Nov. 14–15.

NATIONAL CONSTRUCTION CONFERENCE, Chamber of Commerce of the United States, Washington, D. C., Nov. 16–17.

### REGIONAL AND LOCAL

AMERICAN WATER WORKS ASSOCIATION, section meetings: Oshkosh, Wis., Oct. 30–Nov. 1; Utica, N. Y., Nov. 2–3; Charlotte, N. C., Nov. 6–8.

UNIVERSITY OF MICHIGAN-LIFE CONFERENCE on New Technologies in Transportation, University of Michigan, Ann Arbor, Mich., November 1-3.

AMERICAN SOCIETY OF CIVIL ENGINEERS, Mid-South section, Greenville, Miss., November 3-4.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, Air Conditioning Conference, Lehigh University, Bethlehem, Pa., Nov. 10–11.

AMERICAN WELDING SOCIETY, Pittsburgh Section, Mellon Institute, Pittsburgh, November 15.

AMERICAN SOCIETY OF CIVIL ENGINEERS, Arizona section, annual fall meeting, Phoenix, Ariz., November 25.

### ELECTION AND ACTIVITIES

REGISTRATION TOTALED 125 waterworks men and engineers at the New York State Sewage Works Association fall meeting held at Olean, N. Y., October 6 and 7. N. L. Nussbaumer, of Buffalo, presided. At the Friday


Only the YEARS and the PUNISHMENT of TRAFFIC can prove PIPE PERFORMANCE

Various technical tests and analyses, however important, simply forecast performance expectancy. *Only* actual use can prove performance.

The more than 30 years *in-the-ground* record of GOHI pipe furnishes indisputable evidence of the enduring qualities of GOHI Pure Iron-Copper Alloy — the longest-lived, low-cost ferrous culvert metal. To use GOHI pipe is to enjoy the profitable advantages of complete dependability, extra years of wear, and freedom from costly upkeep.

GOHI PIPE CORRUGATED

New England Bolt Co. . . . . Everett, Mass.
Central Culvert Co. . . . . Ottumwa, Iowa
Capital City Culvert Co. . . . Madison, Wis.
Bancroft & Martin Rolling Mills Co. . S. Portland, Me.
Denver Steel & Iron Works Co. . Denver, Colo.
The Lane Pipe Corporation . . . Bath, N. Y.
Dixie Culvert Mfg. Co. . . . Little Rock, Ark.
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Meets copper-bearing pure iron requirements in all specifications published by nationally recognized specifying authorities.
Do you have a copy of this book? 72-page book of modern culvert practice, containing valuable data and tables, is yours for the asking. Address fabricator nearest you.

GOHI CULVERT MANUFACTURERS, INC., NEWPORT, KY.

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MODERN TRENCHING EQUIPMENT

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The PIONEER MODEL 170

● Compact, strong, powerful, well-built—the Cleveland Pioneer (Model 170) is the up-to-date answer to your requirements for a small mobile unit for all 'round trench to 10 feet deep and 30" wide.

Only 63" in overall width, the Pioneer gives minimum clearance for obstructions at both sides, at all times, allowing you always to dig in center position and eliminating shifting of boom from side to side. Thus time is saved, side strains are eliminated, balance preserved.

Through its exclusive Pivot Conveyor feature, the Pioneer *eliminates expensive dirt re-handling*. No longer do you need worry about where you are going to place the excavated material, as it is dug. The Pivot Conveyor, pivoting about its axis in a 180 degree arc solves this problem. Let us show you how the Cleveland Pioneer will save you money on more jobs, in more places. Write today.

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*The* BROWNING CRANE & SHOVEL *Co.*

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RAIL CRANES SHOVELS DRAGLINES ZEE ROTATORS

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DIESEL GASOLINE STEAM ELECTRIC

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40 YEARS OF LEADERSHIP

CRAWLER, TRUCK AND WAGON SHOVELS DRAGLINES CRANES ● HOES

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**Here is the IDEAL TRAILER**

*for 90% of all operations*

EXPERIENCE Built It

ROGERS

PERFORMANCE Sold It

40 tons capacity, 12 wheels on six rocking axles. Electrically welded for lightness with strength. 8 or 10 wide as desired, in a few moments. Easy to load and unload. Comparatively light to haul. WRITE FOR INFORMATION.

ROGERS BROTHERS CORPORATION

135 Orchard St. Albion, Penna.


morning session, Nelson H. Fuller, sanitary engineer of the Cattaraugus County Department of Health, and William A. Ryan, sanitary chemist of Rochester, were speakers at the morning session. A paper entitled "Study of the Development of Sewage Oxidation by a Trickling Filter," prepared jointly by F. W. Gilcreas, associate sanitary chemist, and W. W. Sanderson, New York State Department of Health, was read at the opening of the first afternoon session. Then the meeting was given over to a symposium on "An Operator's Day at the Sewage Treatment Plant," led by C. C. Agar of the New York State Department of Health. At the evening session, Nelson M. Fuller showed moving picture reels on high-speed photography. On the second day, during the morning session Nelson W. Hartz, Mine Safety Appliance Corporation, gave a discussion on safety devices. This was followed by a description of the Olean sewage treatment works and the Wellsville plant. The afternoon of the second day was given over to inspection trips.

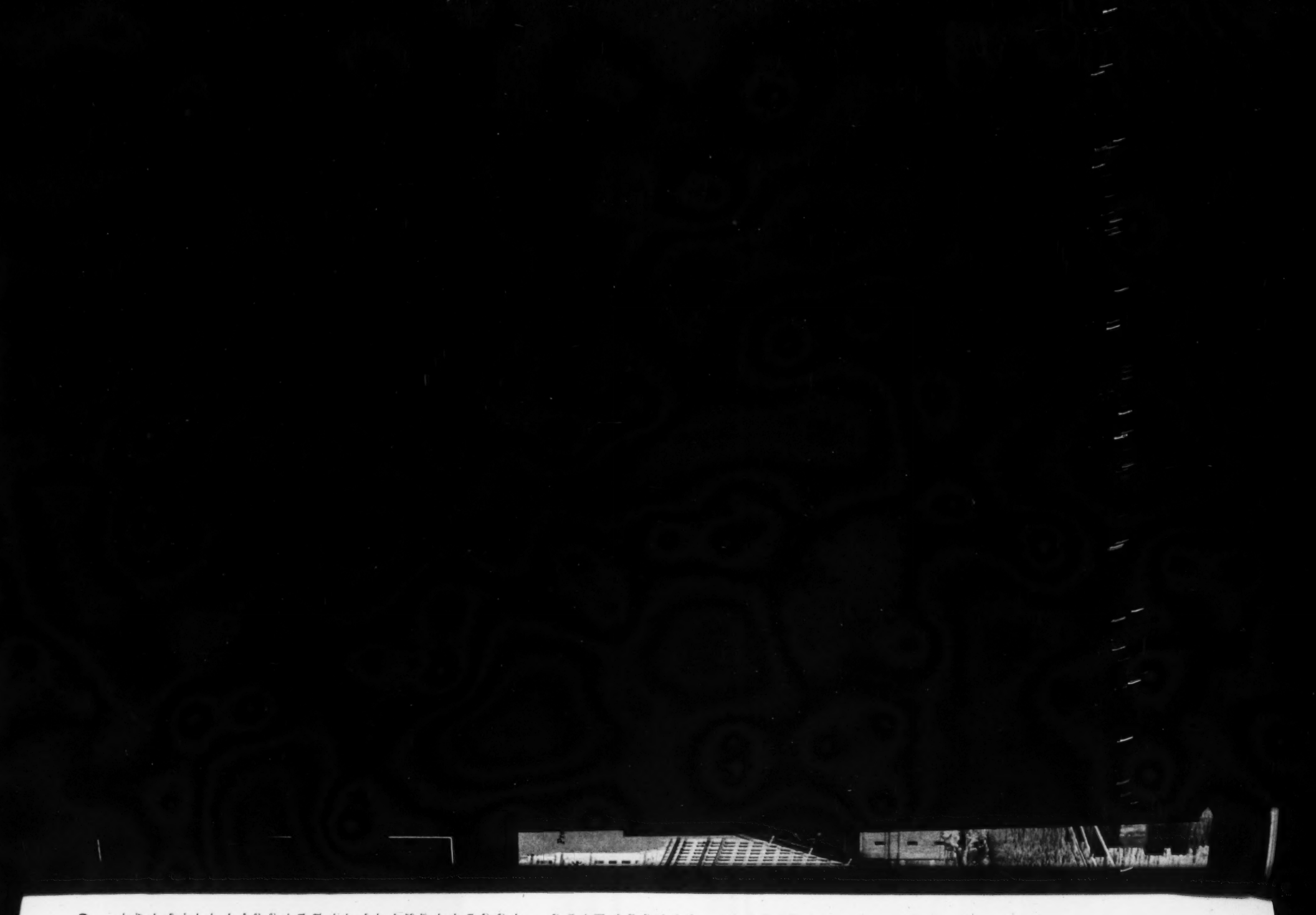
THE ARKANSAS CHAPTER of the Associated General Contractors, on October 5, elected the following directors: D. F. Jones, G. W. May and William Peterson, all from Little Rock, and S. M. Dixon from Warren. These men, with the following officers, make up the board of directors: Ben M. Hogan, president, D. B. Hill, vice-president, R. T. Higgins, vice-president, and Ray Metzger, secretary.

MOTION PICTURES covering the background, purpose and technical details of the TVA program were shown to the Raleigh, N. C., Engineers Club, October 9, by M. F. Price, engineer of the industrial hygiene division of the North Carolina Board of Health.

THE NORTH CAROLINA Building Trades Council, at a meeting at Wilmington, October 8, adopted a resolution commending the "general friendly relations" between organized labor and contractors of the state. The groups voted to strengthen ranks against the threatened invasion of building trades field by the C.I.O

## *Research Conferences*

OHIO STATE UNIVERSITY, fourth annual industrial research conference, Columbus, Ohio, Nov. 3–4.

## *Civil Service Examinations*

CITY OF BUFFALO, N. Y.: Inspector of buildings, $2400 annually. Examinations before Municipal Civil Service Commission, City Hall, Nov. 9.